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Operations Manual
Volume 2
Delta Air Lines, Inc.

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General

The airplanes listed in the table below are covered in the operations manual. The numbers are used to distinguish data peculiar to one or more, but not all of the airplanes. Where data applies to all airplanes listed, no reference is made to individual airplane numbers.

The table permits flight crew correlation of configuration differences by Registry Number in alpha/numeric order within an operator's fleet for airplanes covered in this manual. Configuration data reflects the airplane as delivered configuration and is updated for service bulletin incorporations in conformance with the policy stated in the introduction section of this chapter.

Airplane number is supplied by the operator. Registry number is supplied by the national regulatory agency. Serial and Model numbers are supplied by Airbus.

A-320

Ship Number	Registry Number	Serial Number	Tabulation Number
3209	N209US	0118	A-320-211
3210	N310NW	0121	A-320-211
3211	N311US	0125	A320-211
3212	N312US	0152	A-320-211
3213	N313US	0153	A-320-211
3214	N314US	0160	A-320-211
3215	N315US	0171	A-320-211
3216	N316US	0192	A-320-211
3217	N317US	0197	A-320-211
3218	N318US	0206	A-320-211
3219	N319US	0208	A-320-211
3220	N320US	0213	A-320-211
3221	N321US	0262	A-320-211
3222	N322US	0263	A-320-211
3223	N323US	0272	A-320-211
3224	N324US	0273	A-320-211
3225	N325US	0281	A-320-211
3226	N326US	0282	A-320-211
3227	N327NW	0297	A-320-211
3228	N328NW	0298	A-320-211
3229	N329NW	0306	A-320-211
3230	N330NW	0307	A-320-211
3231	N331NW	0318	A-320-211
3232	N332NW	0319	A-320-211

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Ship Number	Registry Number	Serial Number	Tabulation Number
3233	N333NW	0329	A-320-211
3234	N334NW	0339	A-320-212
3235	N335NW	0340	A-320-212
3236	N336NW	0355	A-320-212
3237	N337NW	0358	A-320-212
3238	N338NW	0360	A-320-212
3239	N339NW	0367	A-320-212
3240	N340NW	0372	A-320-212
3241	N341NW	0380	A-320-212
3242	N342NW	0381	A-320-212
3243	N343NW	0387	A-320-212
3244	N344NW	0388	A-320-212
3245	N345NW	0399	A-320-212
3247	N347NW	0408	A-320-212
3248	N348NW	0410	A-320-212
3249	N349NW	0417	A-320-212
3250	N350NA	0418	A-320-212
3251	N351NW	0766	A-320-212
3252	N352NW	0778	A-320-212
3253	N353NW	0786	A-320-212
3254	N354NW	0801	A-320-212
3255	N355NW	0807	A-320-212
3256	N356NW	0818	A-320-212
3257	N357NW	0830	A-320-212
3258	N358NW	0832	A-320-212
3259	N359NW	0832	A-320-212
3260	N360NW	0903	A-320-212
3261	N361NW	0907	A-320-212
3262	N362NW	0911	A-320-212
3263	N363NW	0923	A-320-212
3264	N364NW	0962	A-320-212
3265	N365NW	0964	A-320-212
3266	N366NW	0981	A-320-212

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Ship Number	Registry Number	Serial Number	Tabulation Number
3267	N367NW	0988	A-320-212
3268	N368NW	0996	A-320-212
3269	N369NW	1011	A-320-212
3270	N369NW	1037	A-320-212
3271	N371NW	1535	A-320-212
3272	N372NW	1633	A-320-212
3273	N373NW	1641	A-320-212
3274	N374NW	1646	A-320-212
3275	N375NC	1789	A-320-212
3276	N376NW	1812	A-320-212
3277	N377NW	2082	A-320-211
3278	N378NW	2092	A-320-211

A-319

Ship Number	Registry Number	Serial Number	Model
3101	N301NB	1058	A319-114
3102	N302NB	1062	A319-114
3114	N314NB	1191	A319-114
3115	N315NB	1230	A319-114
3116	N316NB	1249	A319-114
3117	N317NB	1324	A319-114
3118	N318NB	1325	A319-114
3119	N319NB	1346	A319-114
3120	N320NB	1392	A319-114
3121	N321NB	1414	A319-114
3122	N322NB	1434	A319-114
3123	N323NB	1453	A319-114
3124	N324NB	1456	A319-114
3125	N325NB	1483	A319-114
3126	N326NB	1498	A319-114
3127	N327NB	1501	A319-114
3128	N328NB	1520	A319-114
3129	N329NB	1543	A319-114
3130	N330NB	1549	A319-114

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Ship Number	Registry Number	Serial Number	Model
3131	N331NB	1567	A319-114
3132	N332NB	1570	A319-114
3133	N333NB	1582	A319-114
3134	N334NB	1659	A319-114
3135	N335NB	1662	A319-114
3136	N336NB	1683	A319-114
3137	N337NB	1685	A319-114
3138	N338NB	1693	A319-114
3139	N339NB	1709	A319-114
3140	N340NB	1714	A319-114
3141	N341NB	1738	A319-114
3142	N442NB	1746	A319-114
3143	N343NB	1752	A319-114
3144	N344NB	1766	A319-114
3145	N345NB	1774	A319-114
3146	N346NB	1796	A319-114
3147	N347NB	1800	A319-114
3148	N348NB	1810	A319-114
3149	N348NB	1815	A319-114
3151	N351NB	1820	A319-114
3152	N352NB	1824	A319-114
3153	N353NB	1828	A319-114
3154	N354NB	1833	A319-114
3155	N355NB	1839	A319-114
3157	N357NB	1875	A319-114
3158	N358NB	1897	A319-114
3159	N359NB	1923	A319-114
3160	N360NB	1959	A319-114
3161	N361NB	1976	A319-114
3162	N362NB	1982	A319-114
3163	N363NB	1990	A319-114
3164	N364NB	2002	A319-114
3165	N365NB	2013	A319-114
3166	N366NB	2026	A319-114
3168	N368NB	2039	A319-114

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Ship Number	Registry Number	Serial Number	Model
3169	N369NB	2047	A319-114
3170	N370NB	2087	A319-114
3171	N371NB	2095	A319-114

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General

The manufacturer has developed normal and non-normal procedures for the A319/320 aircraft. Delta Air Lines, Inc. has modified some of these procedures for simplification and standardization, when appropriate, with other aircraft operated by Delta Air Lines, Inc. Finally, the FAA has approved the procedures presented in this Operations Manual.

These procedures are intended to be followed during normal ground operations and in flight. Deviations from these procedures should be made only with good cause and based on the safest course of action. The captain's best judgment must be applied if an abnormality occurs that is not covered by these procedures.

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Corrections to the Manual

Log on to the Delta Flight Operations Portal, http://dlnet.delta.com and submit a Publications Change Request (PCR) to correct any errors or discrepancies discovered in this manual, or to submit a suggested change to any Aircraft Operating Manual, Volume 1, Volume 2, Quick Reference Handbook (QRH), Flight Crew Training Manual (FCTM), Normal Checklist, Airway Manual (AM), Flight Operations Manual (FOM), Operating Experience (OE/TOE) Guide, Flight Crew Bulletin (FCB), or Flight Operations Bulletin (FOB).

There are links to the PCR form on each fleet page and also on the Flight Ops Manuals/Library Services page. Once submitted, the PCR is automatically routed to the applicable Fleet Technical Manager and Technical Writer for that manual.

Organization

The operations manual is organized in the following manner.

Volume 1

- Preface - Contains general information regarding the manual's purpose, structure, and content. It also contains lists of abbreviations, a record of revisions and a list of effective pages.
- Limitations - Covers operational limitations.
- Normal Procedures - Covers all amplified normal operating procedures and are based on a thorough analysis of crew activity required to operate the aircraft, and reflect the latest knowledge and experience available.
- Normal Operational Information - Contains reference material used to support normal procedures.
- Supplementary Procedures is organized by system and covers:
  - any procedure that is non-routine in nature
  - any first-flight-of-the-day test or other systems test
  - guidance on lengthy operating procedures
  - adverse weather procedures and guidance
- Differences - Notes differences between aircraft models and variants.

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Volume 2

- Preface - Contains general information regarding the manual's purpose, structure, and content. It also contains lists of abbreviations, a record of revisions and a list of effective pages.
- Contains general aircraft and systems information. These chapters are generally subdivided into sections covering controls and indicators and systems descriptions.

QRH

- Non-normal checklists - Contains checklists used to manage non-normal situations.
- Non-Normal Operational Information - Contains reference material used to support non-normal procedures.
- Non-Normal Checklist Instructions - Contains non-normal checklist instructions; evacuation flow/philosophy.
- Revision Record - Contains general information regarding the manual's purpose, structure, and content. It also contains lists of abbreviations, a record of revisions and a list of effective pages.

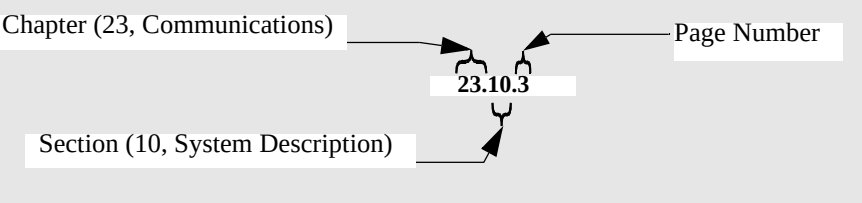
FCTM

- Preface - Contains general information regarding the manual's purpose, structure, and content. It also contains lists of abbreviations, a record of revisions and a list of effective pages.
- Provides information and recommendations on aircraft operations, maneuvers, and techniques.

Page Numbering

This manual uses a decimal page numbering system. The page number is divided into three fields; chapter, section, and page. An example of a page number for the Normal Procedures chapter follows:

Example Page Number



Warnings, Cautions, and Notes

The following levels of written advisories are used throughout the manual and are not to be confused with ECAM messages, which are identified in separate text.

Warning - A warning is an instruction about a hazard that if ignored could result in injury, loss of aircraft control, or loss of life. A warning will appear prior to the applicable step or item.

WARNING: Do not pressurize any hydraulic or pneumatic system until clearance is obtained from Maintenance.

Caution - A caution is an instruction concerning a hazard that if ignored could result in damage to equipment. A caution will appear prior to the applicable step or item.

CAUTION: Do not set takeoff thrust until oil temperature is above 50°C.

Note - A note provides amplified information, instruction, or emphasis. A note will appear after the applicable step or item.

Note: The checklist must not be modified in any way.

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General

The following abbreviations may be found throughout the manual. Some abbreviations may also appear in lowercase letters. Abbreviations having very limited use are explained in the chapter where they are used.

A	
ABNORM	Abnormal
ABS	Absolute
ABV	Above
A/C	Aircraft
AC	Alternating Current or Aircraft
ACARS	Aircraft Communications Addressing and Reporting System
ACCEL	Accelerate(d) Acceleration
ACE	Actuator Control Electronics
ACM	Air Cycle Machine
ACMP	Alternating Current Motor Pump/Electric Hydraulic Pump
ACMS	Aircraft Condition Monitoring System
ACP	Audio Control Panel
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
ADM	Air Data Module
ADP	Air Driven Pump Air Driven Demand Hydraulic Pump
ADR	Air Data Reference
AED	Automatic External Defibrillator

AFDC	Autopilot Flight Director Computer
AFDS	Autopilot Flight Director System
AFE	Above Field Elevation
AFM	Airplane Flight Manual (FAA approved)
AFM - DPI	Airplane Flight Manual - Digital Performance Information
AFS	Automatic Flight System (Autopilot or Autothrottle)
A/G	Air/Ground
AGL	Above Ground Level
AH	Alert Height
AHRS	Attitude Heading Reference System
AI	Anti-Ice
AIDS	Aircraft Integrated Data System
AIL	Aileron
AIMS	Airplane Information Management System
ALFA	Safe Stall Margin Speed
ALT	Altitude
ALT ACQ	Altitude Acquire
ALT HOLD	Altitude Hold
ALTM	Altimeter
ALTN	Alternate
AM	Amplitude Modulation
AMB	Ambient
AMI	Airline Modifiable Information
AMP	Amperes
ANNUNC	Annunciator

ANP	Actual Navigational Performance
ANT	Antenna
ANU	Aircraft Nose Up
AOA	Angle of Attack
AOC	Airline Operational Communication Data Link
A/P	Autopilot
APB	Auxiliary Power Breaker
APD	Approach Progress Display
APL	Airplane
APP or APPR	Approach
APU	Auxiliary Power Unit
AR	Authorization Required
ARINC	Aeronautical Radio, Incorporated
ARPT	Airport
ARR	Arrival
ART	Automatic Reserve Thrust
A/S	Airspeed
ASA	Autoland Status Annunciator
ASAP	As Soon As Possible
ASI	Airspeed Indicator
A/SKID	Anti-Skid
ASP	Audio Selector Panel
ASR	Airport Surveillance Radar
ASSY	Assembly
ASYM	Asymmetry
A/T	Autothrottle
ATA	Actual Time of Arrival

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ATC	Air Traffic Control
A/THR	Auto Thrust Function
ATIS	Automated Terminal Information Service
ATM	Assumed Temperature Method
ATT	Attitude
ATTND	Attendant
AUG	Augmentation
AUTO	Automatic
AUTO–THROT	Autothrottle
AUX	Auxiliary
AVAIL	Available
AVM	Airborne Vibration Monitor
AVS	Audio Visual System
AWABS	Automated Weight and Balance System
AWI	Altitude Warning Indicator
AWY	Airway
B	
BAL	Balance
BARO	Barometric
BAT	Battery
B/C or B/CRS or BAC or BCS	Back Course
BCL	Battery Charge Limiter
BFE	Buyer Furnished Equipment
BFO	Beat Frequency Oscillator
BIT	Built-In Test
BITE	Built-In Test Equipment
BK	Brake
BKGRD	Background
BKR	Breaker
BLD	Bleed
BLW	Below

BMC	Bleed Air Monitoring Computer
BMV	Brake Metering Valve
BRG	Bearing
BRT	Bright
BSCU	Braking Steering Control Unit
BTB(S)	Bus Tie Breaker(s)
BTC	Bus Tie Contactor
BTL	Bottle
BTL DISCH	Bottle Discharge (fire extinguisher)
BTMS	Brake Temperature Monitoring System
C	
C	Captain or Celsius or Center or Cool
CAA	Civil Aviation Authority
CADC	Central Air Data Computer
CALSEL	Call Select
CANC/RCL	Cancel/Recall
CANPA	Constant Angle Non-Precision Approach
CAP	Capture
CAPT	Captain
CAS	Calibrated Airspeed
CAWS	Central Aural Warning System
CB or C/B	Circuit Breaker
CCA	Central Control Accuator
CCD	Cursor Control Device
CCW	Counterclockwise
CDI	Course Deviation Indicator
CDL	Configuration Deviation List
CDS	Common Display System
CDU	Control Display Unit
CFDS	Centralized Fault Display System

CFIT	Controlled Flight Into Terrain
CFM	Cubic Feet per Minute
CG	Center of Gravity
CHAN	Channel
CHG	Change
CHKL	Checklist
CHR	Chronograph
CHRGR	Charger
CIDS	Cabin Intercommunication Data System
CIS	Cabin Interphone System
CKD	Checked
CKT	Circuit
CL	Close
CLB	Climb
CLMP	Computer Lockout Manual Power
CLR	Clear
CLSD	Closed
CMD	Command
CMPTR	Computer
CNX	Cancelled
CO	Company
COMM	Communication
COMP	Comparator
COMPT	Compartment
CON	Continuous
COND	Condition
CONFIG	Configuration
CONN	Connection
CONT	Control
COOL	Cooling
CORR	Correction
CO RTE	Company Route
CP	Control Panel
CPCS	Cabin Pressure Control System

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CRC	Continuous Repetitive Chime
CRM	Crew Resource Management
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CSEU	Control System Electronic Unit
CSM/G	Constant Speed Motor/Generator
CSTR	Constraint
CTL	Control
CTR	Center
CU	Control Unit
CVR	Cockpit Voice Recorder
CW	Clockwise
CWS	Control Wheel Steering
D	
DA	Decision Altitude
DA(H)	Decision Altitude (Height)
DC	Direct Current
DCU	Display Concentrator Unit
DCV	Directional Control Valve
D/D	Direct Descent
DDA	Derived Decision Altitude (MDA +50 feet)
DDG	Dispatch Deviations Guide
DDRMI	Digital Distance & Radio Magnetic Indicator
DECEL	Decelerate(d)
DECR	Decrease
DED	Dedicated
DEG	Degree
DEL	Delete
DEM	Demand
DEP	Departure
DEP ARR	Departure Arrival

DEPR	Depressurize
DES	Descent
DEST	Destination
DET	Detector
DEU	Display Electronic Unit
DEV	Deviation
DFCS	Digital Flight Control System
DFDAU	Digital Flight Data Acquisition Unit
DFDR	Digital Flight Data Recorder
DFGC	Digital Flight Guidance Computer
DFGS	Digital Flight Guidance System
DH	Decision Height
DIFF	Differential
DIR	Direct
DIR TO	Direct To
DISC	Disconnect
DISCH	Discharge
DISCONT	Discontinued
DISP	Dispatch
DIST	Distance
DK	Deck
DMC	Display Management Computer
DME	Distance Measuring Equipment
DN	Down
DNTKFX	Down Track Fix
DPC	Display Processing Computer
DR	Door
DSP	Display Select Panel
DSPL	Display
DTG	Distance to Go
DTW	Distance to Waypoint
DU	Display Unit

E	
EADI	Electronic Attitude Director Indicator
EBU	Engine Build-Up
ECAM	Electronic Centralized Aircraft Monitor
ECB	Electronic Control Box (APU)
ECON	Economy
ECS	Environmental Control System
ECU	Electronic Control Unit
E/D	End of Descent
EDP	Engine Driven Pump
E/E or E&E	Electrical/Electronic or Electrical & Electronic
EEC	Electronic Engine Control
EFB	Electronic Flight Bag
EFI	Electronic Flight Instruments
EFIS	Electronic Flight Instrument System
EFOB	Estimated Fuel On Board Electronic Flight Operations Bulletin
EGPWS	Enhanced Ground Proximity Warning System
EGT	Exhaust Gas Temperature
EHSI	Electronic Horizontal Situation Indicator
EICAS	Engine Indication and Crew Alerting System
EIS	Electronic Instrument System
EIU	Engine Interface Unit
ELAC	Elevator Aileron Computer
ELEC	Electrical
ELEV	Elevator
EMER	Emergency
EMER GEN	Emergency Generator

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ENG	Engine
ENG OUT	Engine Out
ENT	Entry
ENTMT	Entertainment
EO or E/O	Engine Out
EOAP	Electronic Overhead Annunciation Panel
EPC	Electrical Power Center or Electrical Power Contactor
EPR	Engine Pressure Ratio
EPRL	Engine Pressure Ratio Limit
EQPT or EQUIP	Equipment
ER	Extended Range
ERP	Eye Reference Point
ET	Elapsed Time
ETOPS	Extended Range Operation with Twin Engine Airplanes
ETP	Equal Time Point
EVAC	Evacuation
EVBC	Engine Vane and Bleed Control
EVMU	Engine Vibration Monitoring Unit
E/WD	Engine/Warning Display
EXEC	Execute
EXH	Exhaust
EXT	Extend or External
EXTIN	Extinguish(ed)
F	
F	Fahrenheit
FAC	Final Approach Course
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FAF	Final Approach Fix
FAR	Federal Aviation Regulation

FCB	Flight Crew Bulletin
FCC	Flight Control Computer
FCEU	Flight Control Electronics Unit
FCTL or F/CTL	Flight Control
FCTM	Flight Crew Training Manual
FCU	Flight Control Unit
FD, F/D or FLT DIR	Flight Director
FDAU	Flight Data Acquisition Unit
FDEP	Flight Data Entry Panel
FDR	Flight Data Recorder
FDS	Flight Director System
FEXT	Fire Extinguisher
FF	Fuel Flow
FFM	Force Fight Monitor
FGCP	Flight Guidance Control Panel
FGS	Flight Guidance System
FILT	Filter
FIM	Fault Isolation Manual
FIR	Flight Information Region
FL	Flight Level
FL CH or FLCH	Flight Level Change
FLD	Field
FLT	Flight
FLT CTRL	Flight Control
FLPRN	Flaperon
FLUOR	Fluorescent
FMA	Flight Mode Annunciator
FMC	Flight Management Computer
FMCS	Flight Management Computer System
FMGC	Flight Management Guidance Envelope Computer

FMGS	Flight Management Guidance Envelope System
FMS	Flight Management System
F/O or F O	First Officer
FOM	Flight Operations Manual
FPA	Flight Path Angle
F-PLN	Flight Plan
FPM	Feet Per Minute
FPV	Flight Path Vector
FREQ	Frequency
FRM	Fault Reporting Manual
F/S	Fast/Slow
FSEU	Flaps/Slats Electronic Unit
FT	Feet
FWC	Flight Warning Computer
FWD	Forward
FWSOV	Fire Wall Shut Off Valve
FX	Fix
G	
GA	Go–Around
GAL	Gallon
GB(S)	Generator Breakers
GCU	Generator Control Unit
GE	General Electric
GEN	Generator
GLC	Generator Line Contactor
GLS	GNSS Landing System
GMT	Greenwich Mean Time
GND or GRD	Ground
GNSS	Global Navigation Satellite System
GOMEX	Gulf of Mexico
GP or G/P	Glide Path
GPM	Gallons Per Minute

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GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GR	Gear
GS	Ground Speed
G/S	Glide Slope
GW	Gross Weight
H	
HAA	Height Above Airport
HAT	Height Above Touchdown
HDG	Heading or Hydraulic Driven Generator
HDG REF	Heading Reference
HDG SEL	Heading Select
HF	High Frequency
HG	Mercury
HGS	Head-Up Guidance System (HGS® is a registered trademark of Flight Dynamics.)
HI	High
HLD	Hold
HMU	Hydrau-Mechanical Unit
HOR or HORIZ	Horizontal
HORZ	Horizon
HP	High Pressure
HPA	Hectopascals
HPSOV	High Pressure Shut Off Valve
HPV	High Pressure Valve
HSI	Horizontal Situation Indicator
HTR	Heater
HUD	Head-Up Display
HYD	Hydraulic
HZ	Hertz
I	
IAF	Initial Approach Fix
IAN	Integrated Approach Navigation
IAS	Indicated Airspeed
I/C	Inspection/Check or Intercom
ICAO	International Civil Aviation Organization
ICU	Instrument Comparator Unit
IDENT	Identification
IDG	Integrated Drive Generator
IDU	Interactive Display Unit
IFE	In-Flight Entertainment System
IFR	Instrument Flight Rules
IGN	Ignition
IGS	Instrument Guidance System
ILLUM	Illuminate, Illuminated
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
IMP	Imperial
IN	Inch(es)
INC	Incorporated
INCR	Increase
INBD	Inboard
IND	Indicator
IND LTS	Indicator Lights
INFLT	In flight or in-flight
INHB	Inhibit
INIT	Initialization
INOP	Inoperative
INSTR	Instrument
INT or INTPH	Interphone
INTC	Intercept
INTC CRS	Intercept Course
INV	Static Inverter
IP	Instructor Pilot
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
ISDU	Inertial System Display Unit
ISFD	Integrated Standby Flight Display
ISLN	Isolation
IVSI	Instantaneous Vertical Speed Indicator
J	
JAA	Joint Aviation Authority
K	
K or KTS	Knots
KCAS	Knots Calibrated Airspeed
KEAS	Knots, Equivalent Airspeed
KGS	Kilograms
KHZ	Kilohertz (Kilocycles)
KIAS	Knots Indicated Airspeed
KW(S)	Kilowatt(s)
L	
L	Left
LAF	Load Alleviation Function
LAT	Latitude
LAT REV	Lateral Revision
LAV	Lavatory
LBS	Pounds
LCD	Liquid Crystal Display
LCN	Load Classification Number
LD	Load
LDA	Localizer-type Directional Aid
LDG	Landing
LDG ALT	Landing Altitude

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LE	Leading Edge
L/G	Landing Gear
LGW	Landing Gross Weight
LH	Left Hand
LIM	Limit
LIM SPD	Limit Speed
LKD	Locked
LMM or MM	Localizer Middle Marker
LN	Left Nose
L NAV or LNAV	Lateral Navigation
LO	Low
LOC	Localizer
LOC-BC	Localizer Back Course
LOGO	Logographic
LOM	Locator Outer Marker
LON or LONG	Longitude
LP	Low Pressure
LPV	Localizer Performance with Vertical Guidance
LR	Long Range or Left Rear
LRC	Long Range Cruise
LRRA	Low Range Radio Altimeter
LRU	Line Replaceable Unit
LSB	Lower Side Band
LSU	Lavatory Service Unit
LSK	Line Select Key
LT	Light
LVL	Level
LVL CH or LVL/CH	Level Change
LW	Left Wing
LWR	Lower
LWR CTR	Lower Center
LWR DSPLY or LWR DSPL	Lower Display

M	
M	Mach
MAC	Mean Aerodynamic Chord
MAG	Magnetic
MAHP	Missed Approach Holding Point
MAINT	Maintenance
MALF	Malfunction
MAN	Manual
MAP	Missed Approach Point
MASI	Mach/Airspeed Indicator
MAX	Maximum
MB	Millibar
MCC	Maintenance Control Center
MCDP	Maintenance Control and Display Panel
MCDU	Multi-purpose Control and Display Unit
MCO	Maintenance Carry Over
MCP	Mode Control Panel
MCT	Maximum Continuous Thrust
MCU	Modular Concept Unit
MDA	Minimum Descent Altitude
MDA(H)	Minimum Descent Altitude (Height)
MDM	Mechanical Dispatch Manual
MEA	Minimum Enroute Altitude
MED	Medium
MEL	Minimum Equipment List
MEW	Manufacturer’s Empty Weight
MFD	Multifunction Display
MHZ	Megahertz
MI	Miles
MIC	Microphone

MIN	Minimum
MKR	Marker
MLS	Microwave Landing System
MLW	Maximum Landing Weight
MM	Middle Marker
MMO	Maximum Mach Operating Speed
MNPS	Minimum Navigation Performance Specification
MOCA	Minimum Obstruction Clearance Altitude
MOD	Modify or Module
MON	Monitor
MORA	Minimum Off Route Altitude
MPH	Miles Per Hour
MSA	Minimum Safe Altitude
MSG	Message
MSGS RCVD	Messages Received
MSL	Mean Sea Level
M-SPD	Manual Speed
MSU	Mode Selector Unit
MTG	Miles To Go
MTOW	Maximum Take-Off Weight
MTRS	Meters
MTW	Maximum Taxi Weight
MU	Management Unit
MUH	Minimum Use Height
MUX	Multiplexer
MZFW	Maximum Zero Fuel Weight
N	
N	Normal
NAC	Nacelle
NADP	Noise Abatement Departure Procedures

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NAR	North American Route
NAV	Navigation
NAV RAD	Navigation Radio
ND	Navigation Display
NEUT	Neutral
NEG	Negative
NLG	Nose Landing Gear
NLT	No Later Than
NM	Nautical Mile(s)
NNC	Non-Normal Checklists
NNM	Non-Normal Maneuvers
NPS	Navigation Performance Scales
NORM	Normal
NW	Nose Wheel
NWS	Nose Wheel Steering
N1	Low Pressure Rotor Speed
N2	High Pressure Rotor Speed (Pratt & Whitney and GE engines) or Intermediate Pressure Rotor Speed (Rolls Royce Engines)
N3	High Pressure Rotor Speed (Rolls Royce Engines)
O	
OAP	Overhead Annunciator Panel (a.k.a. EOAP)
OAT	Outside Air Temperature
OBS	Observer
OCC	Operations Control Center
ODM	Operational Data Manual
OEW	Operating Empty Weight
OFST	Offset
OHU	Overhead Unit
OM	Outer Marker
OP	Open
OPR	Operate
OPRN	Operation
OUTBD DSPL	Outboard Display
OVHD	Overhead
OVHT	Overheat
OVRD	Override
OVSPD	Overspeed
OXY or O2	Oxygen
P	
PA	Passenger Address
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
PASS	Passenger
PB	Push Button
PBE	Protective Breathing Equipment
PCA	Power Control Actuation
PCP	Pilot Call Panel
PCU	Power Control Unit
PDC	Pitch Data Computer or Performance Data Computer or Pre-Departure Clearance
PDI	Pictoral Deviation Indication
PERF	Performance
PERF INIT	Performance Initialization
PES	Pitch Enhancement System or Passenger Entertainment System
PF	Pilot Flying
PFC	Primary Flight Computer
PFD	Primary Flight Display
PI	Performance Inflight
PIP	Product Improvement Package
PLI	Pitch Limit Indicator
PLT(S)	Pilot(s)
PM	Pilot Monitoring
PMA	Permanent Magnet Alternator
PMC	Power Management Control
PNL	Panel
PO	Outside Air Pressure
POS	Position
POS INIT	Position Initialization
POS REF	Position Reference
PPH	Pounds Per Hour
PPI	Planned Position Indicator
PPOS	Present Position
PRES or PRESS	Pressure
PREV	Previous
PRI	Primary
PRAIM	Predictive Receiver Autonomous Integrity Monitoring
PRED	Prediction
PROC	Procedure
PROC T	Procedure Turn
PROG	Progress
PROT	Protection
PROX	Proximity
P/RST	Push To Reset
PRV	Pressure Regulating Valve
P/S	Pitot/Static
PSI	Pounds Per Square Inch
PSIG	Pounds per Square Inch Gage
PSS	Passenger Service System
PSU	Passenger Service Unit
PTH	Path
PTT	Push To Talk
PTU	Power Transfer Unit

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PWR	Power
PWS	Predictive Windshear System
Q	
Q	Quantity
QFE	Local Station Pressure
QNH	Altimeter Setting
QRH	Quick Reference Handbook
QT	Quart
QTY	Quantity
R	
R	Right
RA	Radio Altitude or Resolution Advisory
RAAC	Rotor Active Clearance Control
RAD	Radio
RAIM	Receiver Autonomous Integrity Monitoring
RAT	Ram Air Temperature or Ram Air Turbine
RCL	Request for Clearance
RDMI	Radio Distance Magnetic Indicator
REC or RCDR	Recorder
RECIR or RECIRC	Recirculation
REF	Reference
RET	Retract
REV	Reverse
RF	Radius-to-Fix (RF) Legs or Refill
RMI	Radio Magnetic Indicator
RMP	Radio Management Panel
RON	Remain Overnight
RNAV or RNV	Area Navigation
RNP	Required Navigational Performance
RPL	Rudder Pressure Limiter
RPM	Revolutions Per Minute
RPR	Rudder Pressure Reducer
RR	Rolls Royce
RSEP	Rudder System Enhancement Program
RST	Reset
RSV	Reserves
RSVR	Reservoir
R/T	Radio Transmit
RTE	Route
RTO	Rejected Takeoff
RTP	Radio Tuning Panel
RUD	Rudder
RVR	Runway Visual Range
RVSM	Reduced Vertical Separation Minimum
RWY	Runway
S	
SA	Special Authorization
SAAAR	Special Aircraft and Aircrew Authorization Required
SAARU	Secondary Attitude Air Data Reference Unit
SAT	Static Air Temperature or Satellite
SB	Service Bulletin
S/B	Speedbrake
SC	Single Chime
S/C	Step Climb
SD	System Display
S/D	Step Descent
SDAC	System Data Acquisition Concentrator
SDCU	Smoke Detection Control Unit
SDF	Simplified Directional Facility
SEC	Spoiler Elevator Computer
SEI	Standby Engine Indicator
SEL	Select
SELCAL	Selective Calling
SENS	Sensitivity
SERV	Service
SFCC	Slat/Flap Control Computer
SG	Symbol Generator
SID	Standard Instrument Departure
SMGCS	Surface Movement and Guidance Control System
SPD	Speed
SPDBRK	Speedbrake
SPD LIM	Speed Limit
SPLR	Spoiler
SRS	Speed Reference System
STA	Station
STAB	Stabilizer
STAR	Standard Terminal Arrival Route
STAT or STS	Status
STAT INV	Static Inverter
STBY	Standby
STD	Standard
STRG	Steering
SW	Switch
SWTG	Switching
SYS	System
T	
T or TRU	True
T or TK or TRK	Track (to a Navaid)
TA	Traffic Advisory
TAA	Terminal Arrival Area
TACAN	Tactical Air Navigation
TAC	Thrust Asymmetry Compensation
TAI	Thermal Anti–Ice
TAS	True Airspeed
TAT	Total Air Temperature

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T/C	Top of Climb
TCA	Terminal Control Area
TCAS	Traffic Alert and Collision Avoidance System
TCI	Thrust Computer Indicator
T/D	Top of Descent
TDZ	Touch Down Zone
TDZE	Touch Down Zone Elevation
TE	Trailing Edge
TEMP	Temperature
TERR	Terrain
TFC	Traffic
TFR	Transfer
THR	Throttle or Thrust
THR HOLD	Throttle Hold
THS	Trimmable Horizontal Stabilizer
TK	Tank
TLA	Throttle Lever Angle
TMC	Thrust Management Computer
TMI	Track Message Identifier
TMSP	Thrust Mode Select Panel
TO or T/O	Takeoff
TOC	Top of Climb
TOD	Top of Descent
TO/GA or TOGA	Takeoff/Go–Around
TOGW	Takeoff Gross Weight
T-P	Turn Point
TPR	Turbine Pressure Ratio
TR	Traffic Resolution
TRK	Track
TRP	Thrust Rating Panel
TRU	Transformer Rectifier Unit
TURB	Turbine or Turbulence

U	
UNLK	Unlock
UNLKD	Unlocked
UNSCHD or UNSCHED	Unscheduled
UPR DSPL	Upper Display
U.S.	United States
USB	Upper Side Band
UTC	Universal Time Coordinated
UTIL	Utility
V	
V	Volt
VA	Design maneuvering speed
VAL	Valve
VANP	Vertical Actual Navigational Performance
VASI	Visual Approach Slope Indicator
VDP	Visual Descent Point
VEF	Speed at Engine Failure
VERT	Vertical
VFE	Maximum Velocity Flaps Extended
VFR	Visual Flight Rules
VG	Vertical Gyro
VHF	Very High Frequency
VIB	Vibration
VLV	Valve
VMC	Visual Meteorological Conditions
VMCA	Minimum Control Airspeed or Single Engine Minimum Control Airspeed
VMCG	Minimum Control Speed Ground
VMO	Maximum Operating Speed
V NAV or VNAV	Vertical Navigation

VOR	VHF Omnidirectional Range
VR	Rotation Speed
VREF	Reference Speed
VRNP	Vertical Required Navigation Performance
V/S	Vertical Speed
VSCF	Variable Speed Constant Frequency
VSD	Vertical Situation Display
VSI	Vertical Speed Indicator
VSID	Vertical Speed Indicator Display
VTK	Vertical Track
V1	Takeoff Decision Speed
V1 (MCG)	Minimum V1 for Control on the Ground
V2	Scheduled Takeoff Target Speed
W	
W	Warm
WATRS	Western Atlantic Route System
WDR	Weight Data Record
WGS-84	World Geodetic System of 1984
WHC	Window Heat Computer
WHL	Wheel
WPT	Waypoint
WT	Weight
WTB	Wing Tip Brake
WXR	Weather Radar
X	
X–FEED	Crossfeed
XFR	Transfer
XMTR	Transmitter
XPDR or XPNDR	Transponder
XTK	Cross Track

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Z	
ZFCG	Zero Fuel Center of Gravity
ZFW	Zero Fuel Weight

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Revision Notification Transmittal Letter

To: All holders of Delta Air Lines, Inc. Operations Manuals.

Subject: Operations Manual Revision.

This revision reflects the most current information available to Delta Air Lines, Inc. through the subject revision date. The following revision highlights explain changes in this revision. General information below explains the use of revision bars to identify new or revised information.

Revision Record

No.	Revision Date	Date Filed
0	July 18, 2013	

No.	Revision Date	Date Filed
1	January 27, 2015	

General

Delta Air Lines issues operations manual revisions to provide new or revised procedures and information. Formal revisions also incorporate appropriate information from previously issued Fleet Bulletins.

The revision date is the approximate date the revision material is distributed and considered current. The revision should be incorporated on the revision date, but may be incorporated as much as 21 days after the revision date.

Formal revisions include a new Revision Record (including Revision Highlights) and a current List of Effective Pages. Use the information on the new Revision Record and List of Effective Pages to verify the operations manual content.

The Revision Record should be completed by the person incorporating the revision into the manual.

Filing Instructions

Consult the List of Effective Pages (P2.5). Pages identified with an asterisk (*) are either replacement pages, new (original) issue pages, or deleted pages. Remove corresponding old pages and replace or add new pages. Remove pages marked DELETED; there are no replacement pages for deleted pages.

Be careful when inserting changes not to throw away pages from the manual that are not replaced. The List of Effective Pages determines the correct content of the manual.

Revision Highlights

Pages containing revised technical and non-technical material have revision bars associated with the changed text or illustration.

Repaginated material not containing technical revisions are identified only by a new page date.

Chapter P2: Preface

Section 3- Abbreviations

P2.3.9 - Changed "Speed Air" to "Airspeed."

Section 4 - Revision Record

P2.4.1 - Changed "Flight Crew Bulletins" to "Fleet Bulletins."

P2.4.1 - Revised "Filing Instructions" for cross fleet standardization.

Chapter 22: Autoflight

Section 10 - System Description

62, 63 - Removed information referencing "Vertical Mode Reversions" section.
87 - 88 - Revised "Vertical Mode Reversions" section.
94 - Revised note to align with "Vertical Mode Reversions" section.

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Section 20 - Controls and Indicators

19 - Changed reference from "SMAC/COM" to "Airway Manual."
19 - Removed "NO DH (W)" from table.

Chapter 23: Communications

Section 15 - Aircraft Communications Addressing and Reporting System (ACARS)

8, 19, 40, 42 - Changed reference from "three letter city code" to "4-letter ICAO code." for clarity.
9 - Revised statement for FUEL BDD to read" Enter "0" to satisfy screen logic."
20 - Revised PDC sample.
25 - Revised title to: NWA REQUEST Page.
41 - Revised statement to "Enter the holding fix....."

Section 20 - Controls and Indicators

16 - Revised statement to "green - Currently not used"

Chapter 28: Fuel

Section 10 - System Description

16 - Updated graphics to only show refueling control panel under wing and not the fuselage.

Section 20 - Controls and Indicators

1 - Updated graphics to only show refueling control panel under wing and not the fuselage.

Chapter 34: Navigation

Section 36 - F-PLN Pages

76-77 - Changed title from "Radial Fix Info" to "Fix Info."
78 - Modified the statement describing the example.
78 - Changed "crosses" to "cross."
96 - 101 - Revised "Alternate Airports" section.
103 - Changed "CHECK GW" to "CHECK WEIGHT" for clarity.

Section 38 - FUEL PRED Page

2- Changed "CHECK GW" to "CHECK WEIGHT" for clarity.

Chapter 58: Emergency Equipment

Section 10 - System Description

2, 3 - Added "Emergency equipment locations depicted in the following graphics are approximate.
For actual locations and quantities, refer to placards located throughout the cabin."

Chapter 85: Warning Systems

Section 20 - Controls and Indicators

4 - Remove statement "such as single engine and direct law landings"

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Chapter 6: Dimensions/General Arrangement

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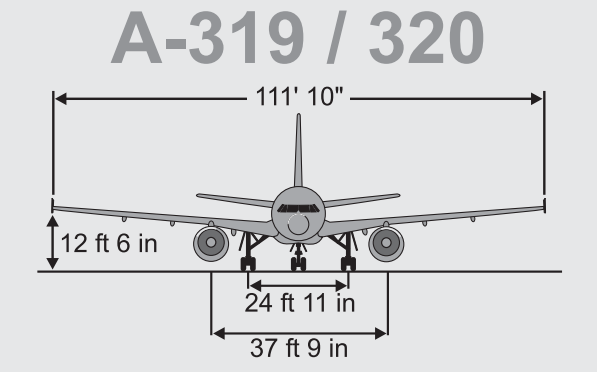
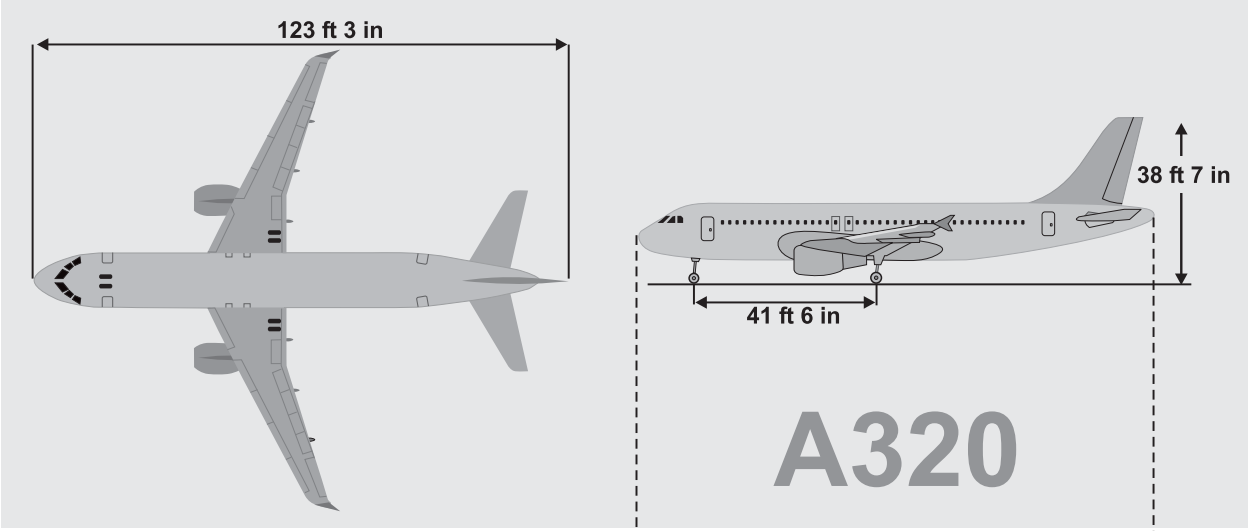
System Description

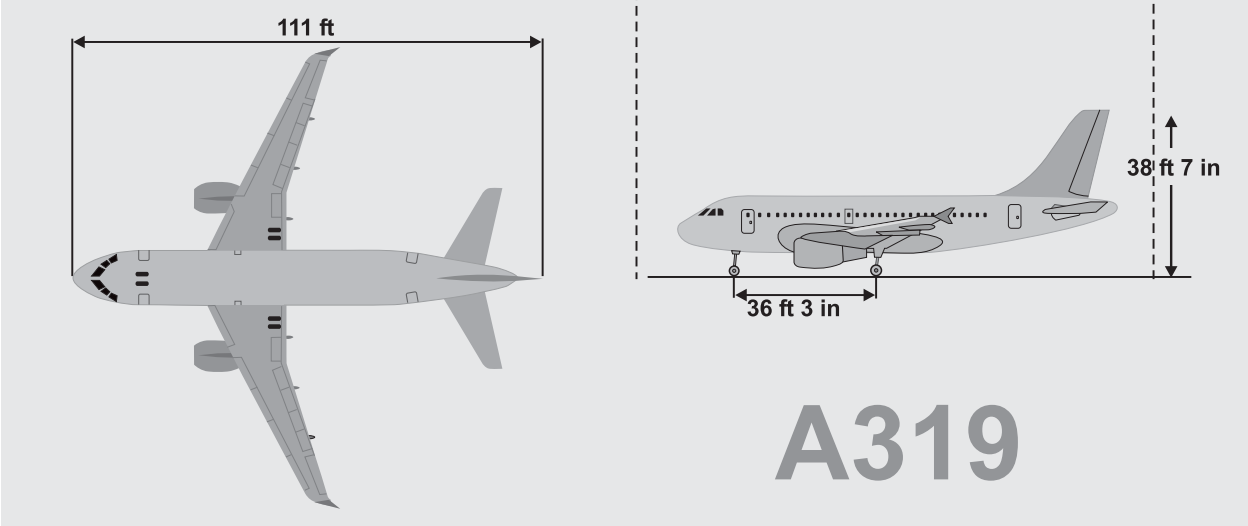
General Arrangement

Crew	The minimum required crew is two pilots and three flight attendants. Seating for two additional flight deck observers (XCM) is provided.
Passengers and Flight Attendants (A320 only)	The A320 can accommodate a total of 150 passengers, with 12 in first class, 18 in Economy Comfort, and 120 in coach class. A total of 5 flight attendant jumpseats are provided.
Passengers and Flight Attendants (A319 only)	The A319 can accommodate a total of 120 passengers, with 12 in first class, 18 in Economy Comfort, and 96 in coach class. A total of 4 flight attendant jumpseats are provided.

Aircraft Dimensions







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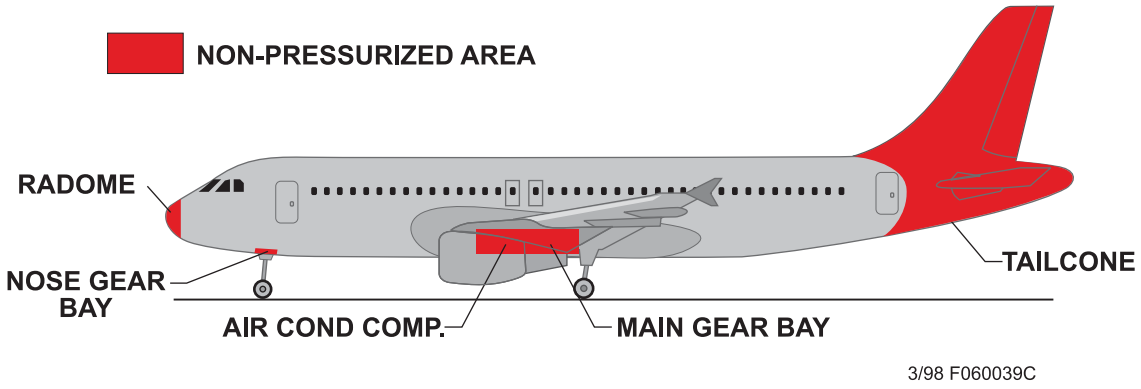
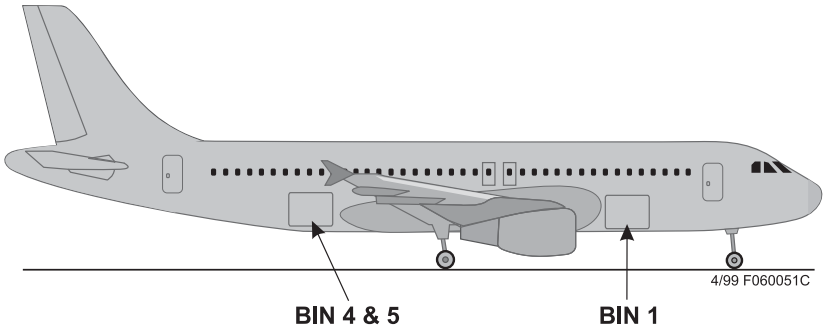
Non-Pressurized Areas

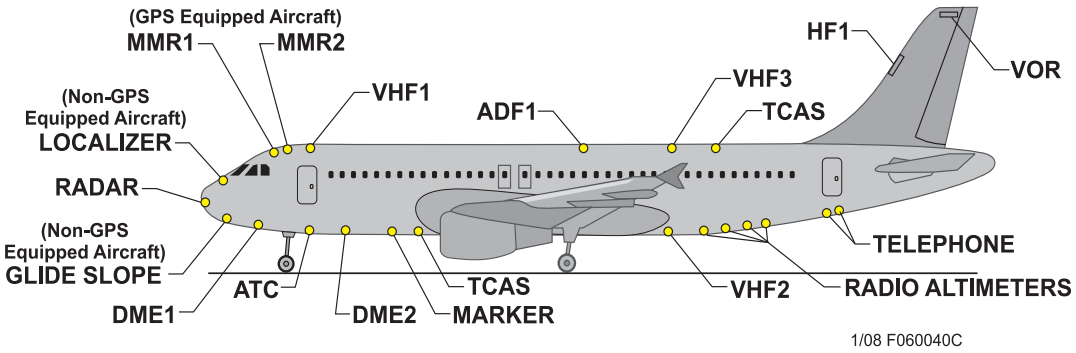


Cargo Bins

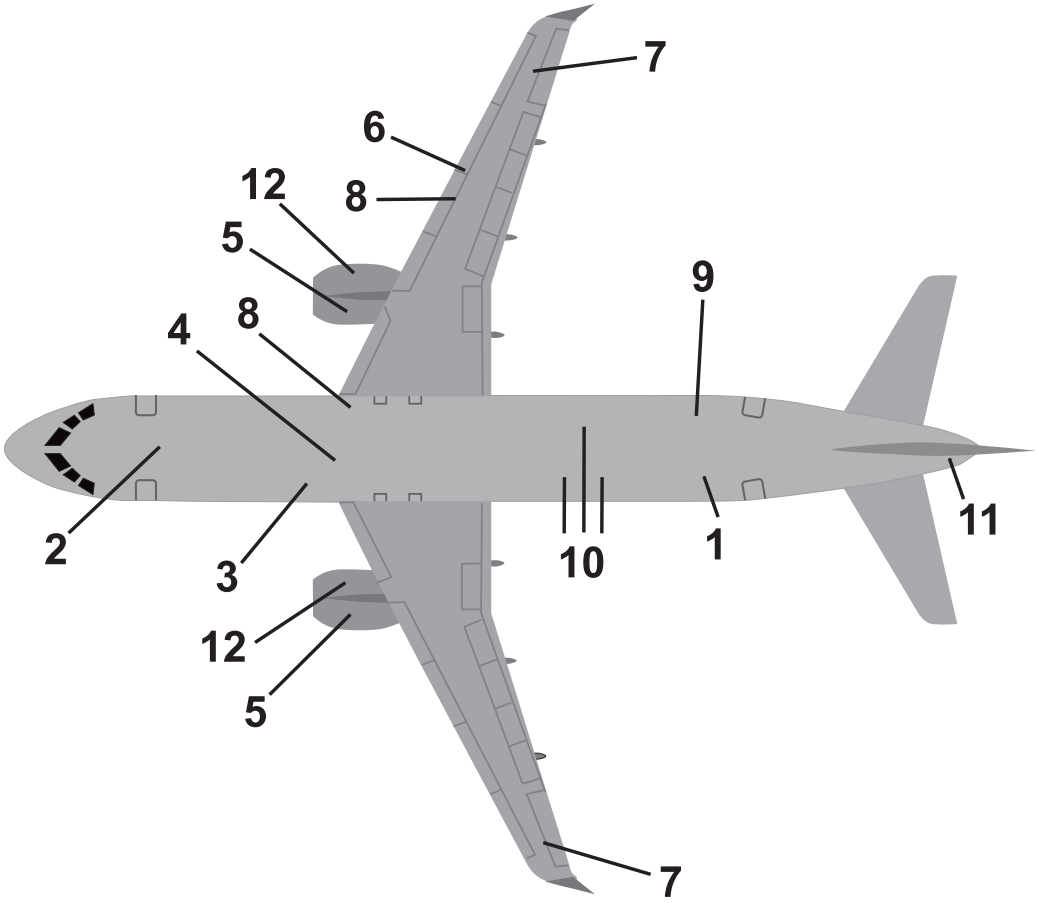
Live animals can be carried only in the aft cargo bin.



Antenna Location



Ground Servicing



1. Potable water servicing
2. EXT PWR receptacle
3. LP air receptacle
4. HP air receptacle
5. Engine oil servicing
6. Refueling control panel
7. Overwing gravity refueling point
8. Fuel coupling
9. Toilet servicing
10. Hydraulic servicing
11. APU oil servicing
12. Engine start valve access

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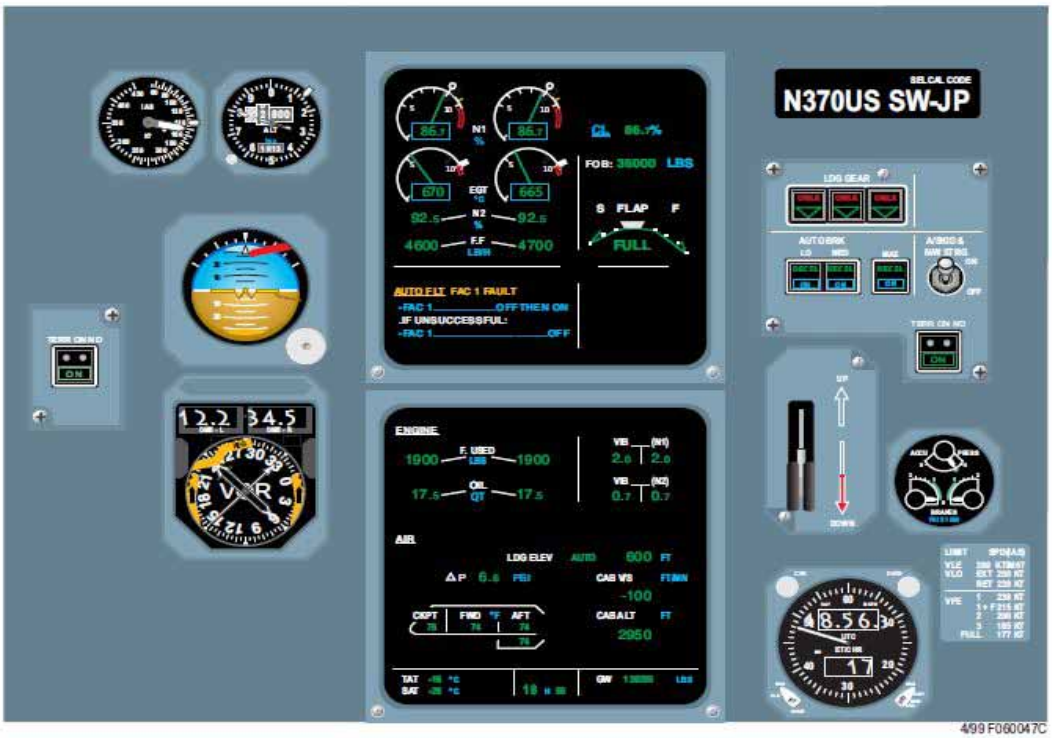
Flight Deck Instrument Panels

Captain's Instrument Panel Diagram

Flight Control Unit and Center Instrument Panel (A320 Only)

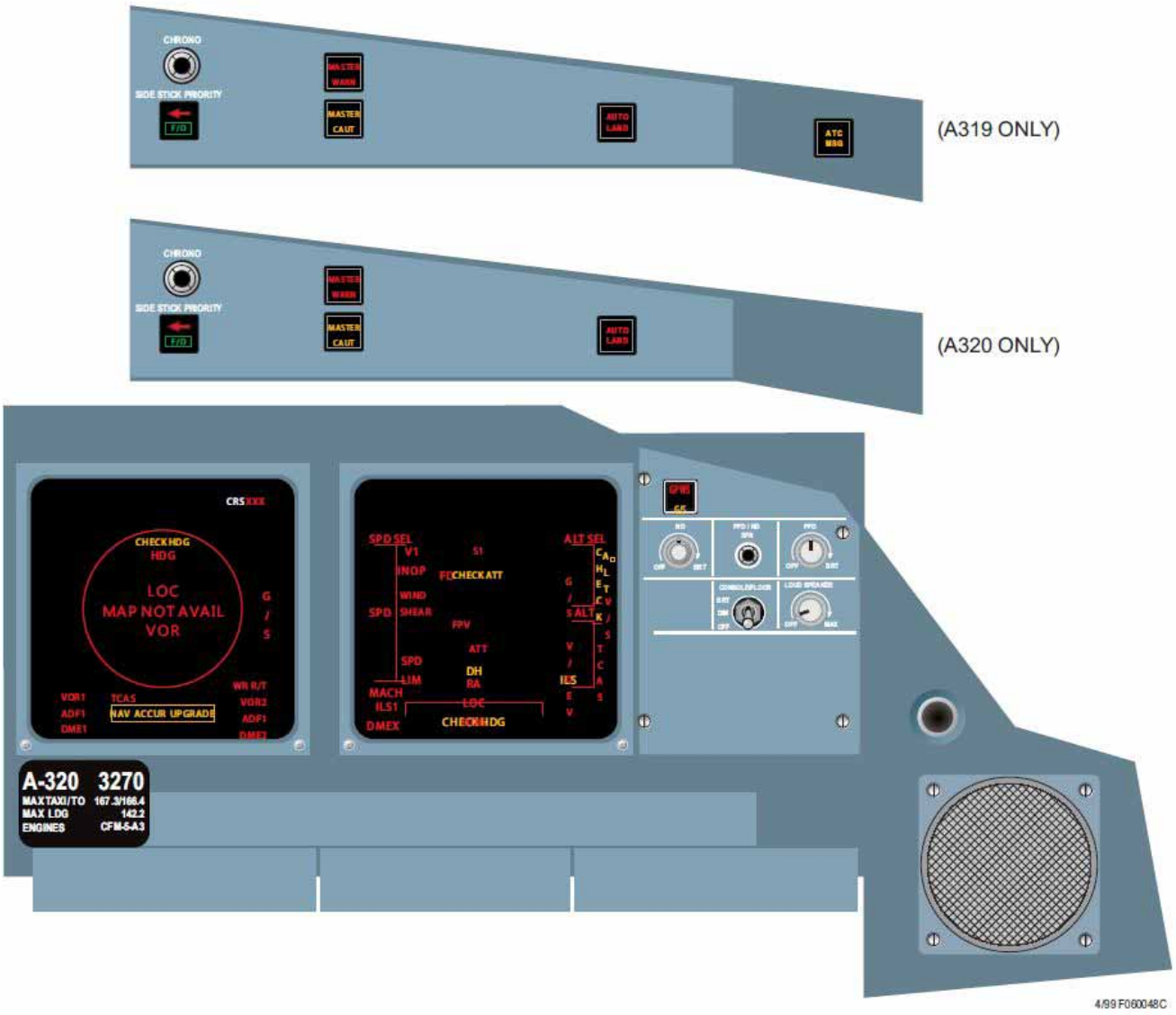
A320 ONLY



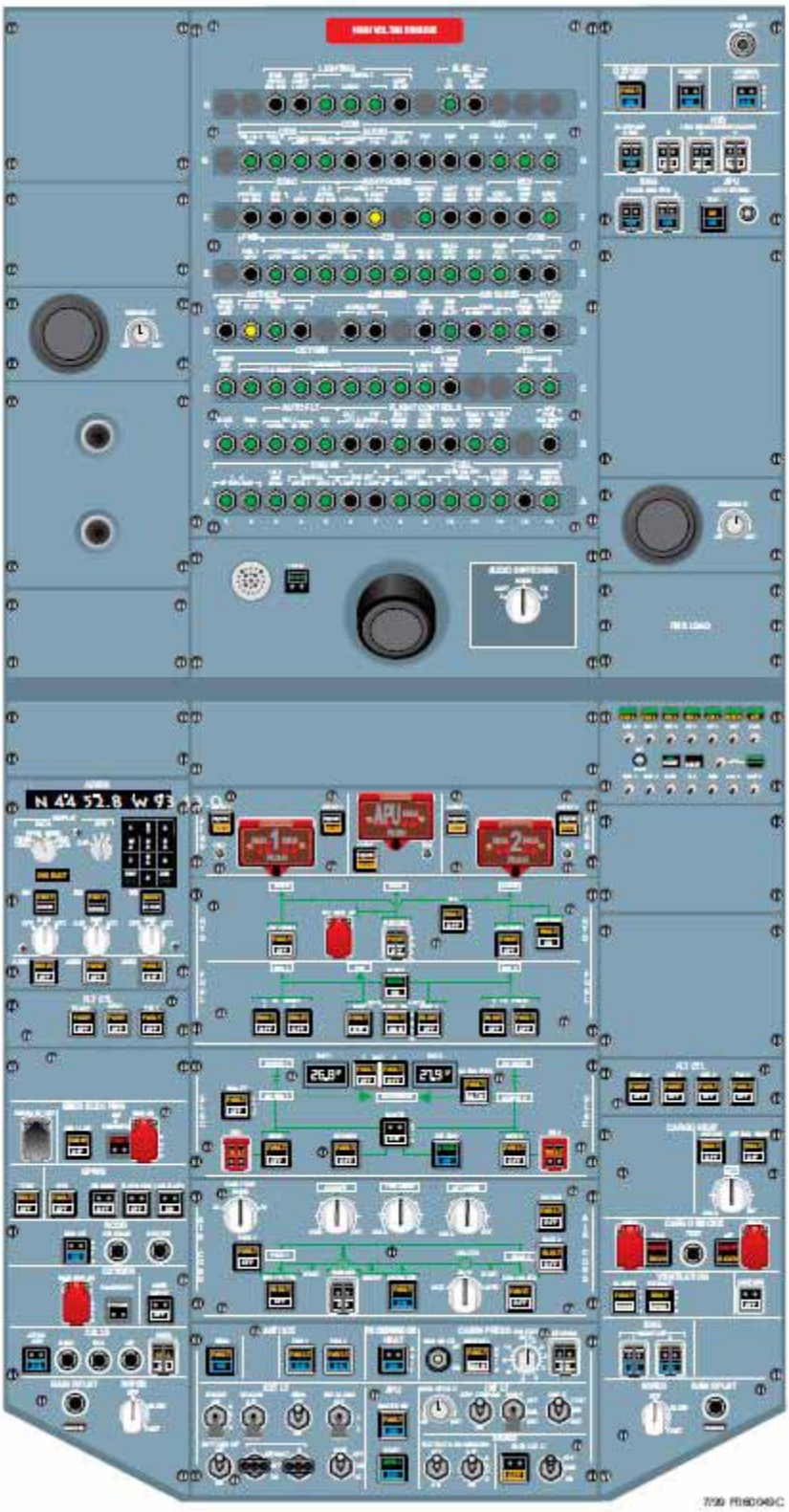
Flight Control Unit and Center Instrument Panel (A319 Only)

A319 ONLY

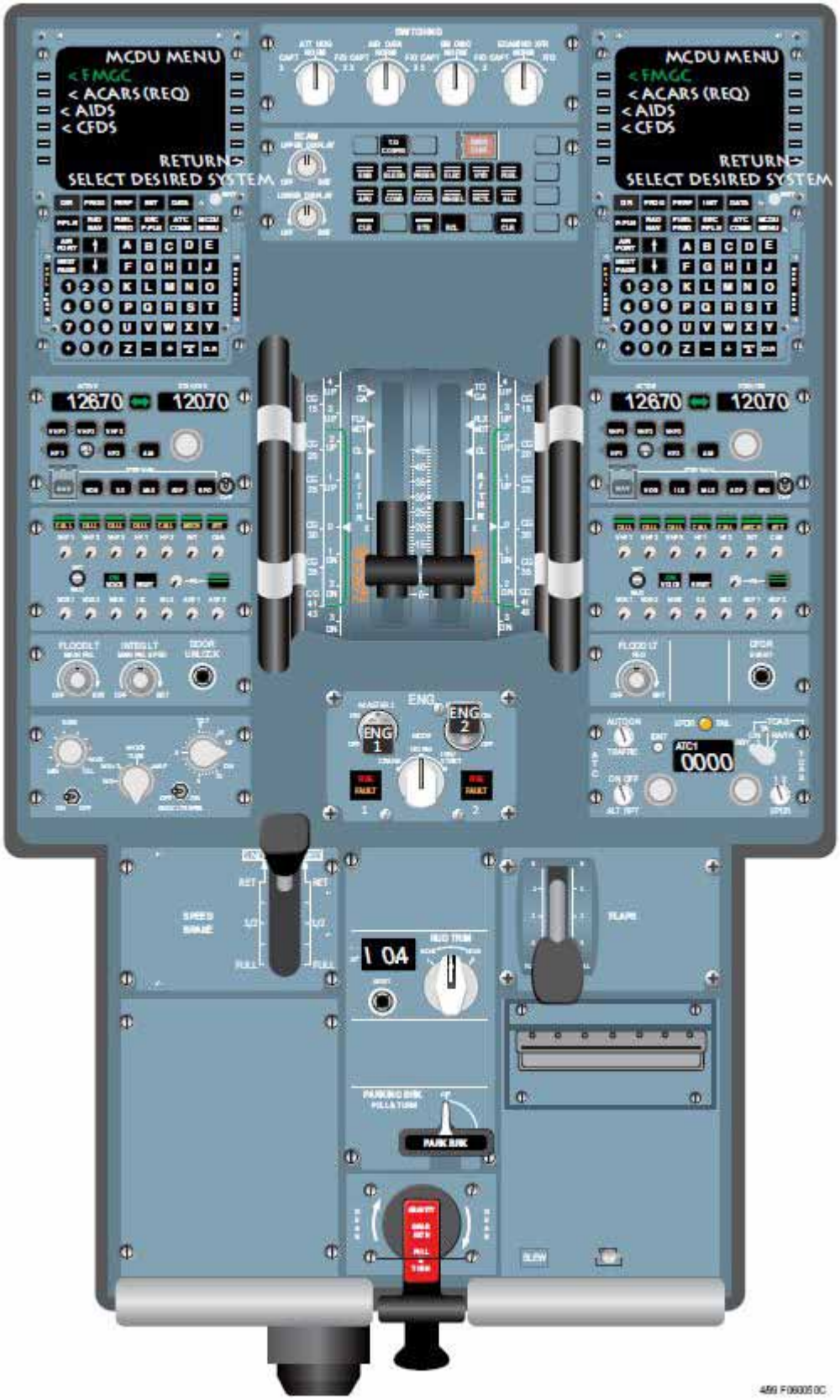
First Officer's Instrument Panel Diagram



Overhead Panel



Pedestal Panel



Chapter 21: Air Conditioning/Pressurization/Ventilation

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Controls and Indicators 21.20.1
- Location of Controls and Indicators 21.20.1
- ECAM COND Page 21.20.2
- ECAM CABIN PRESS Page 21.20.6
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- ECAM CRUISE Page (Air Conditioning Related Items) 21.20.13
- AIR COND Panel 21.20.15
- CABIN PRESS Panel 21.20.17
- VENTILATION Panel 21.20.19
- CARGO HEAT Panel 21.20.22
- Warning/Caution Messages 21.20.24

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Systems Description

General Description

Function

The function of the air conditioning system is to provide ventilation, humidity, and temperature control for the flight deck and cabin. ECAM information related to the air conditioning system can be viewed by selecting the ECAM COND system display page.

The function of the pressurization system is to maintain cabin altitude and cabin vertical speeds at acceptable levels throughout the airplane's operating envelope. ECAM information related to the pressurization system can be viewed by selecting the ECAM PRESS page.

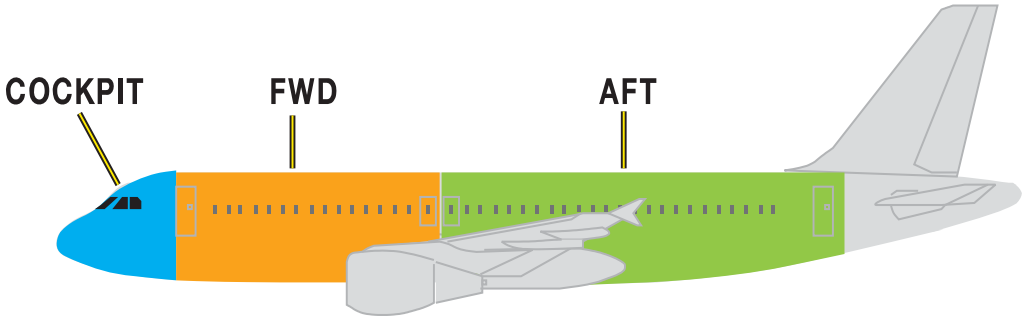
The function of the avionics ventilation system is to maintain the temperature of the avionics system components at acceptable levels. ECAM information related to the avionics ventilation system can be viewed by selecting the ECAM PRESS system display page.

The function of the aft cargo compartment ventilation and heating system is to maintain a safe environment in the aft cargo compartment (suitable for live animals). ECAM information related to the aft cargo compartment ventilation system can be viewed by selecting the ECAM COND system display page.

Air Conditioning System Overview

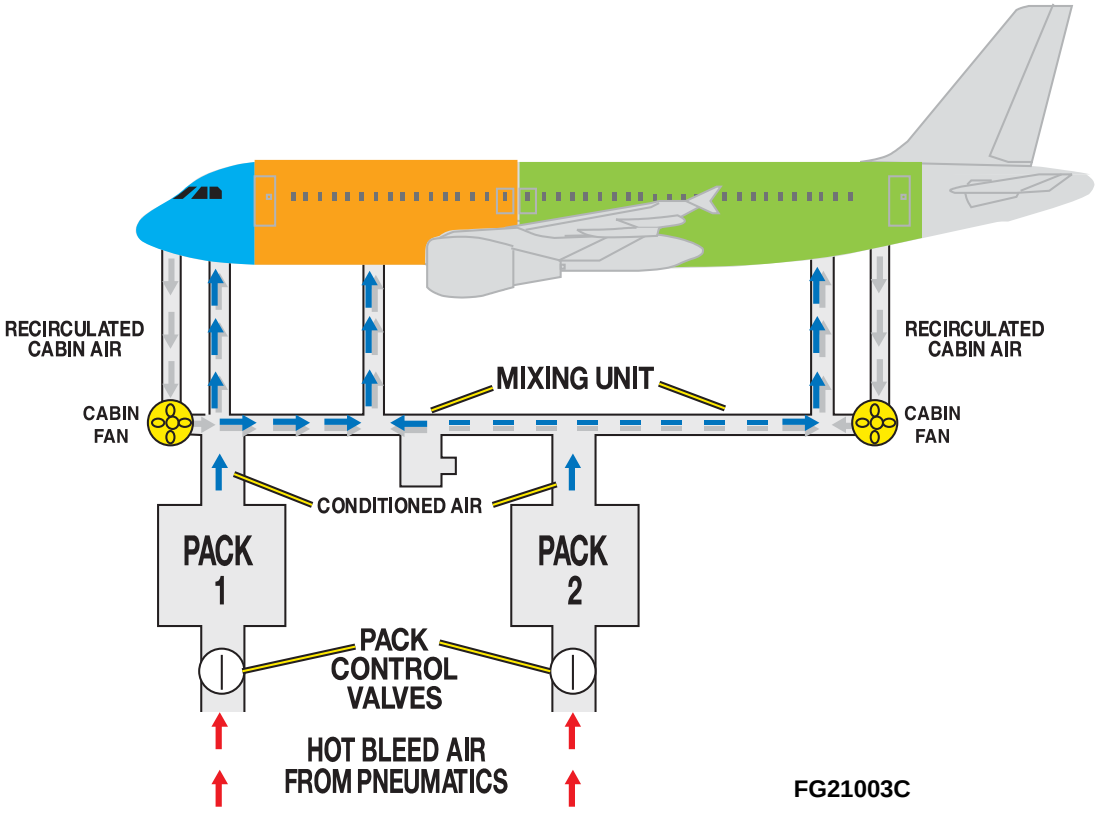
Overview

The air conditioning system allows air in three independent zones to be continuously refreshed and maintained at the selected temperature. The three zones are the COCKPIT, FWD cabin, and AFT cabin.



FG21002C

The air conditioning system uses by hot air from the pneumatic system which is routed through the pack control valves to the packs. The conditioned air leaving the packs is then routed to the mixing unit, where recirculated cabin air is added. This air is then distributed to the three zones.



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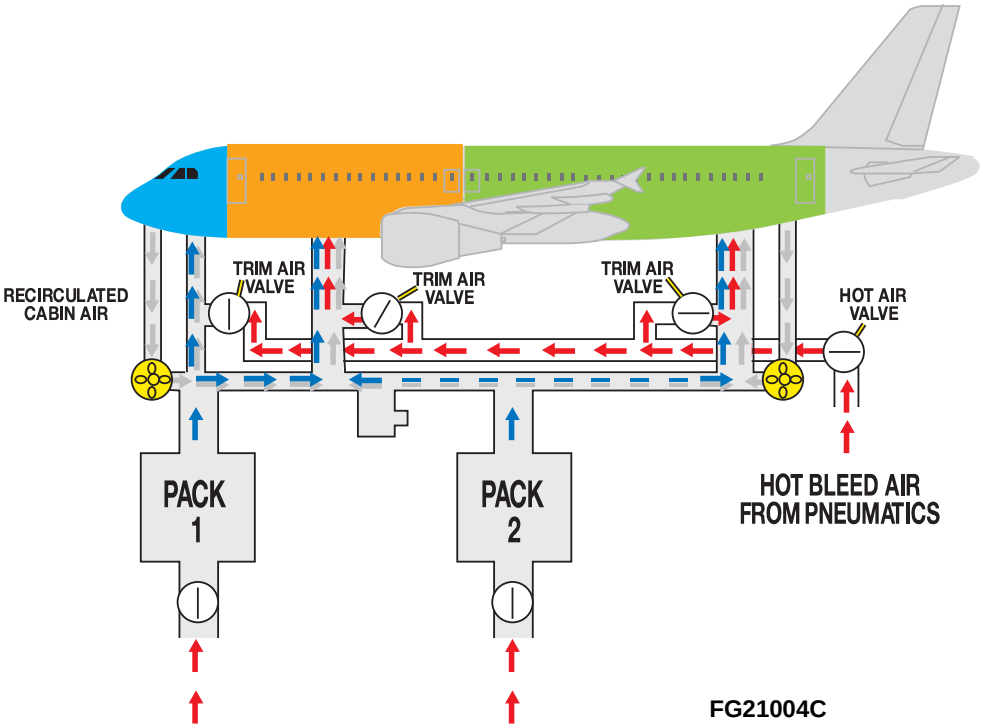
Air Conditioning System Overview (continued)

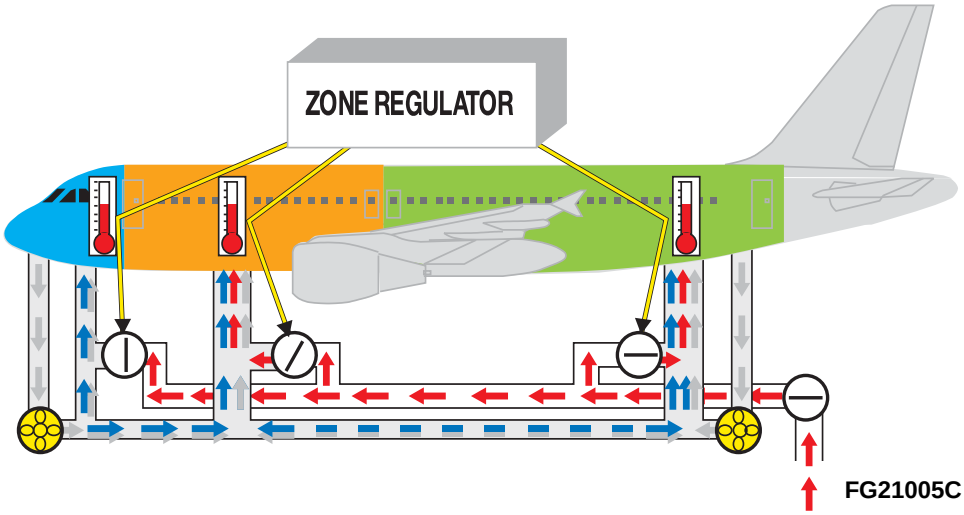
Overview (continued)

Hot bleed air which bypasses the packs can be added to conditioned air that is routed to a particular zone. The trim air valves allow this hot air to mix with conditioned pack air.



FG21004C

The trim air valves optimize the zone temperatures. This is controlled by the zone regulator, which is a computer that senses zone temperatures and adjusts the trim air valves and pack outlet temperatures to meet the zone temperature selected from the flight deck.



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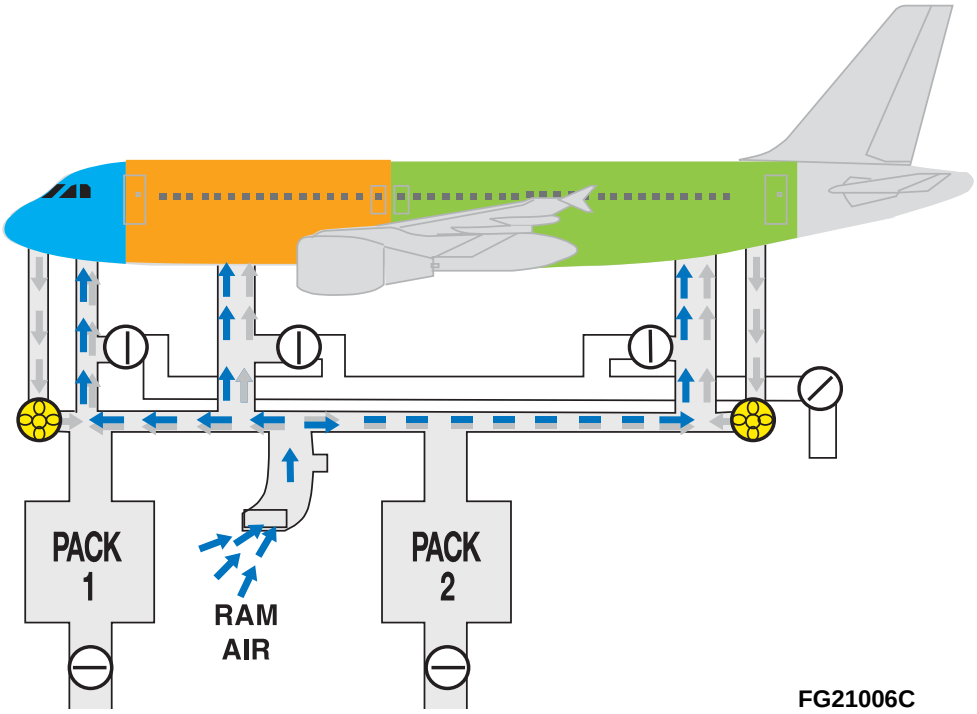
Air Conditioning System Overview (continued)

Overview (continued)

In flight, a ram air inlet can be opened to supply the mixing unit with ambient air if both packs fail or if smoke removal is necessary.



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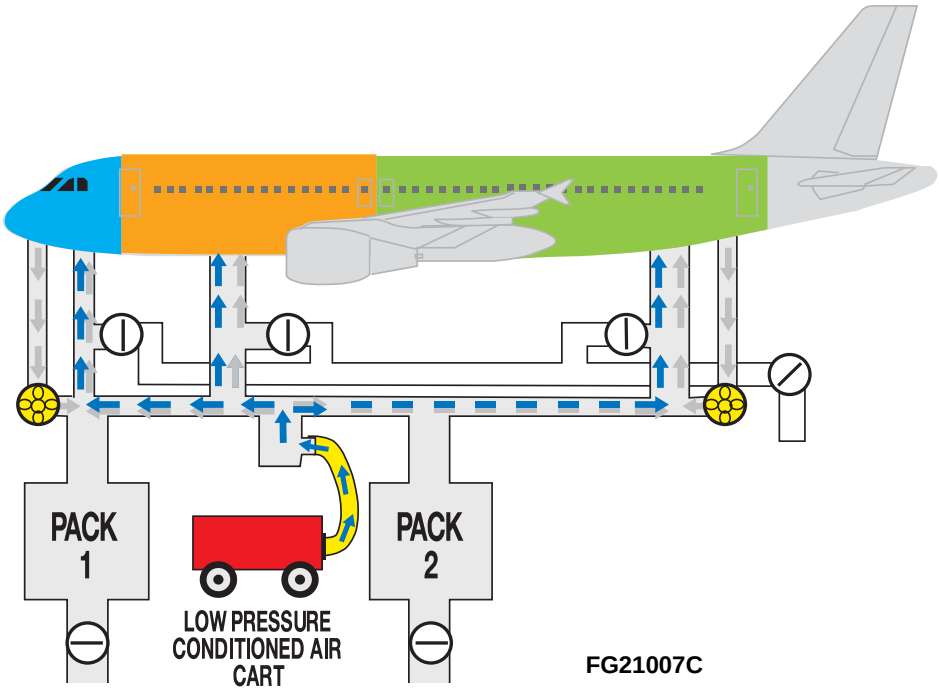
On the ground an air conditioning cart may be used to supply air to the mixing unit. This Low Pressure (LP) air does not go through the packs.



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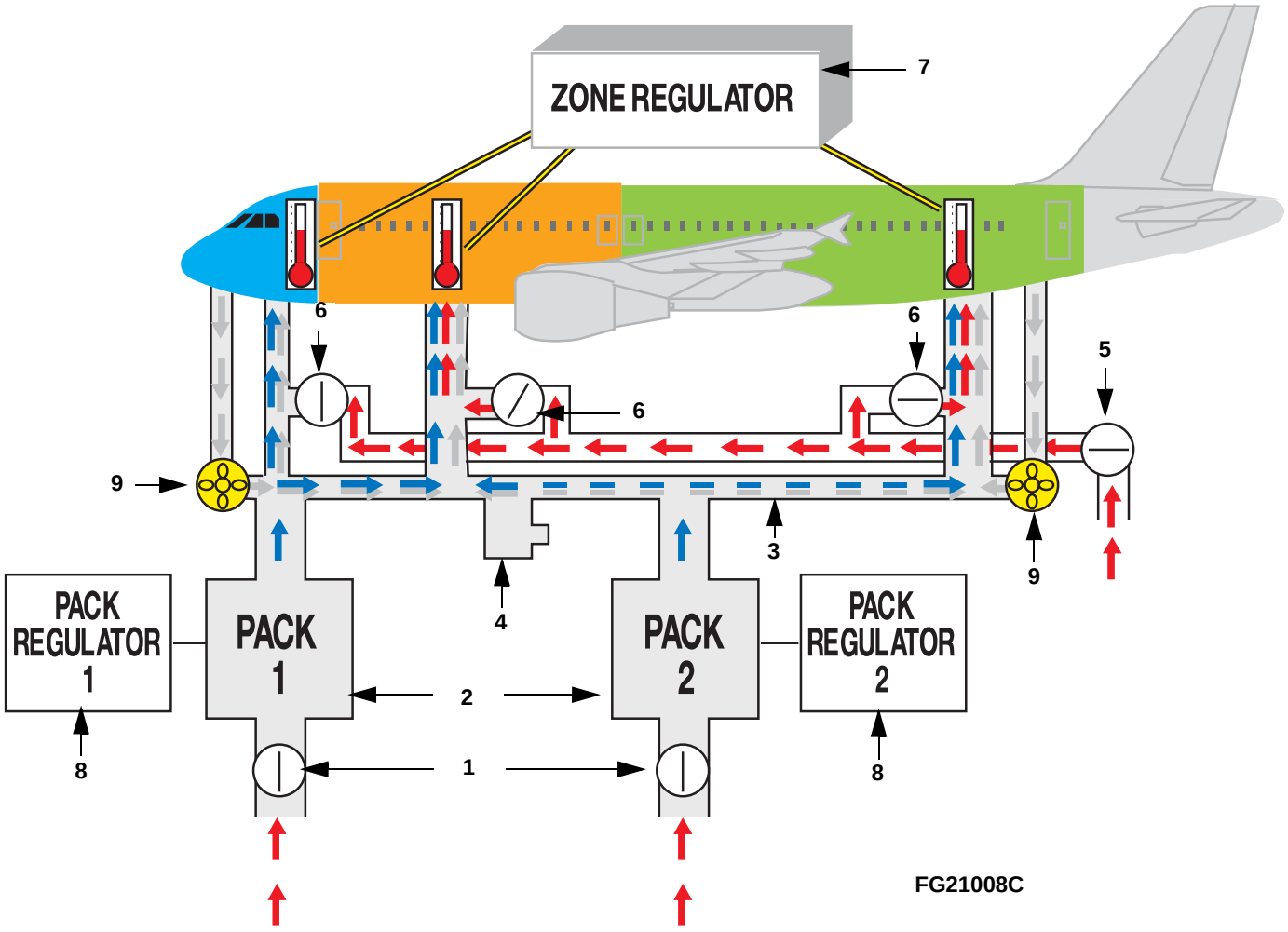
Air Conditioning System Overview (continued)

System Components

Components of the air conditioning system include:

1. two pack control valves,
2. two air conditioning packs,
3. mixing unit,
4. emergency ram air inlet,
5. hot air valve,
6. three trim air valves,
7. zone regulator,
8. two pack regulators, and
9. two cabin fans.



Air Conditioning System Components

1. Pack Control Valves

Pack control valves control the amount of bleed air supplied to the packs and act as shutoff valves. While these valves are electrically controlled via the PACK 1 (2) pbs, they are regulated by the pack regulators.

The pack control valves open and close automatically as a result of computer logic. For example, if a fault is detected in a pack system, the valve automatically closes.

2. Air Conditioning Packs

The air conditioning system includes two air conditioning packs. The packs receive hot bleed air from the pneumatic system and cool it for distribution to the mixing unit. Each pack is controlled by a pack regulator and operates independently of the other.

3. Mixing Unit

The mixing unit mixes conditioned air from the air conditioning packs with recirculated cabin air prior to distribution to the flight deck and cabin. Two cabin recirculation fans draw cabin air into the mixing unit through filters.

From the mixing unit airflow is distributed into three zones: the flight deck, forward cabin, and aft cabin.

The mixing unit also contains a connection for a ground air conditioning cart.

4. Emergency Ram Air Inlet

The emergency ram air inlet directs external air into the mixing unit. The ram air inlet is a scoop on the belly of the aircraft. It is used for cabin ventilation in case both packs are inoperative or to clear the cabin of smoke.

The emergency ram air inlet valve is controlled by the RAM AIR pb on the air conditioning panel. The pb is guarded to prevent accidental selection. When selected ON:

- the ram air valve opens, and
- the outflow valve will fully open when the cabin differential pressure is less than 1 psi.

Indications for the emergency ram air inlet appear on the ECAM BLEED page.

Air Conditioning System Components (continued)

5. Hot Air Valve

The hot air valve controls the supply of hot air to all of the trim air valves which maintain the selected temperature in each zone.

Valve position is controlled by the HOT AIR pb. The valve automatically closes in the event of a fault.

6. Trim Air Valves

A trim air valve is associated with each air conditioning zone and is supplied with hot air from the pneumatic system through the hot air valve.

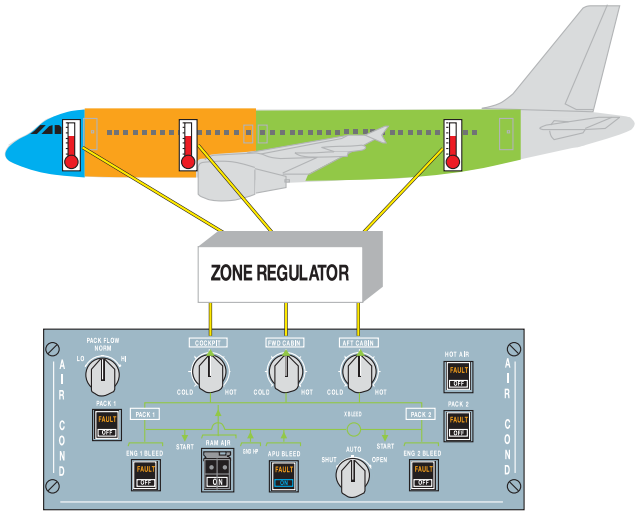
To maintain the selected zone temperature, the trim air valves under control of the zone regulator, add hot air, if necessary, to the air from the mixing unit. This allows for air temperatures to be controlled independently in each zone.

Air Conditioning System Components (continued)

7. Zone Regulator

The zone regulator is a two channel computer that receives inputs from the flight deck controls and from various air temperature and flow sensors. It uses these signals to manage the other air conditioning components to provide selected zone temperatures and optimum airflow rates.

By comparing the cockpit and cabin temperature selectors with actual zone temperatures, the zone regulator determines which zone requires the coldest air. It then directs the pack controllers to deliver airflow at that temperature to the mixing unit. It then adds hot trim air to the other zones as necessary to maintain the temperatures selected.



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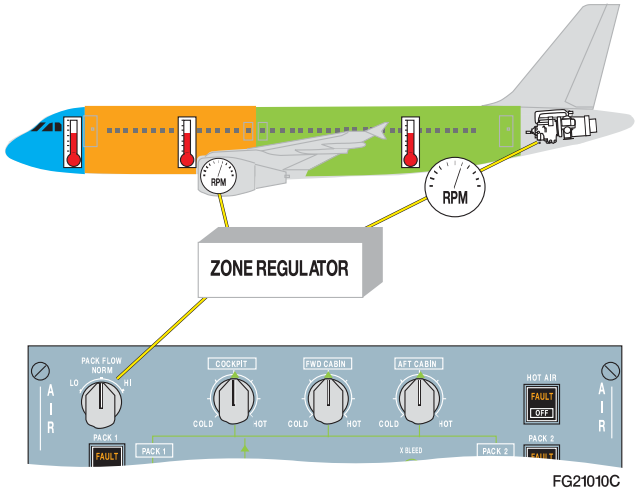
Since the zone regulator is responsible for providing adequate heating and cooling it has the ability to override flight deck selected airflow as needed to maintain the selected temperatures. It can also increase APU speed or engine idle if needed to meet zone temperature requirements.



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Air Conditioning System Components (continued)

7. Zone Regulator (continued)

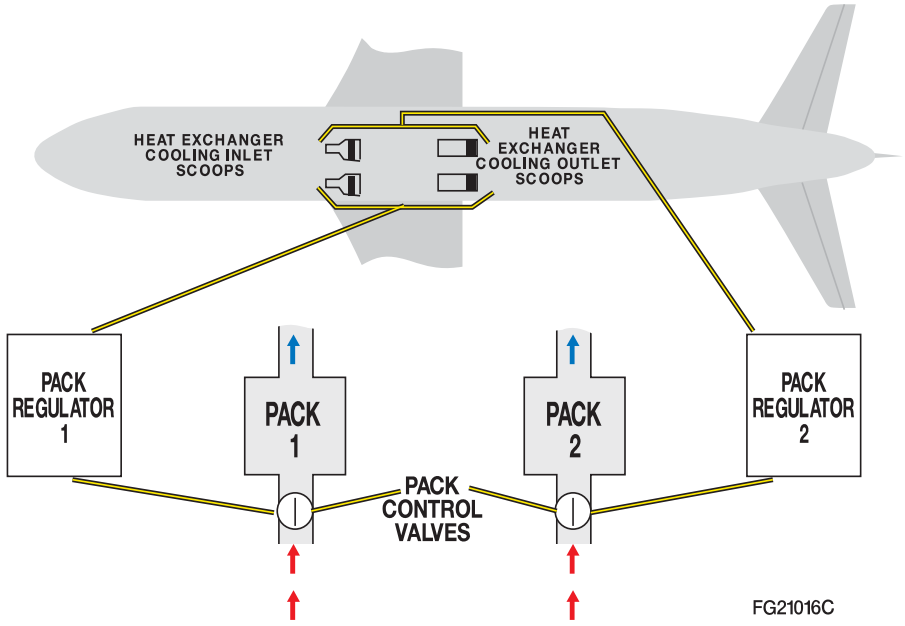
The zone regulator is a two-channel computer. If the primary channel fails, the secondary channel provides backup temperature control. The zone regulator also provides system information to the ECAM and fault warning systems.

8. Pack Regulator

The pack regulator is a two channel computer which receives commands from the zone regulator. There is one pack regulator dedicated to each pack. The pack regulator provides temperature regulation of its associated pack to meet the pack outlet temperature demanded by the zone requiring the coldest air. The pack regulator also provides flow regulation by modulating the associated pack control valve.

The pack regulators also monitor the respective pack for malfunctions and shut the pack down if a fault is detected. Each regulator provides system information to the ECAM and includes a secondary channel in case the primary channel fails.

Scoops for the intake and exhaust of ambient air for heat exchanger cooling are located on the belly of the aircraft. These scoops are controlled by the pack regulator and control the amount of air over the heat exchanger. They automatically close temporarily during takeoff and during touchdown to avoid ingestion of foreign matter.



9.Cabin Fans

Two cabin fans are normally operated at all times to recirculate cabin air back to the mixing unit. These fans can be selected off with the CAB FANS pb.

Air Conditioning Faults

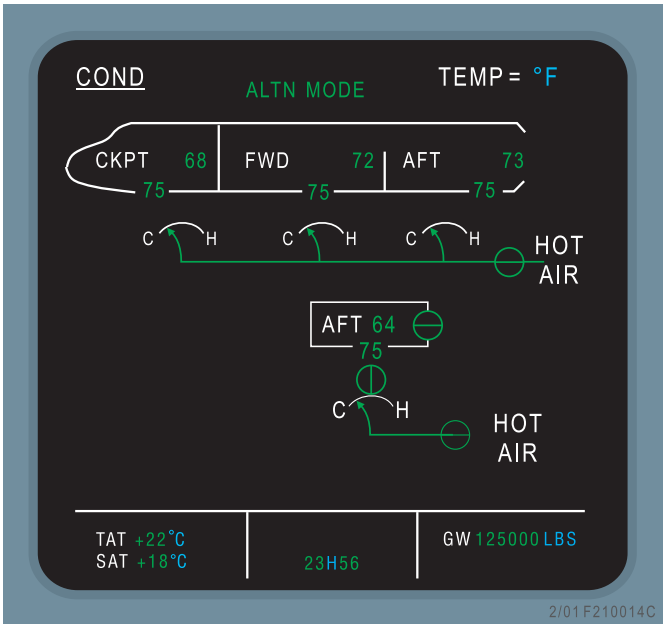
Zone Regulator Faults

If the zone regulator experiences a failure of the primary channel, the following will occur:

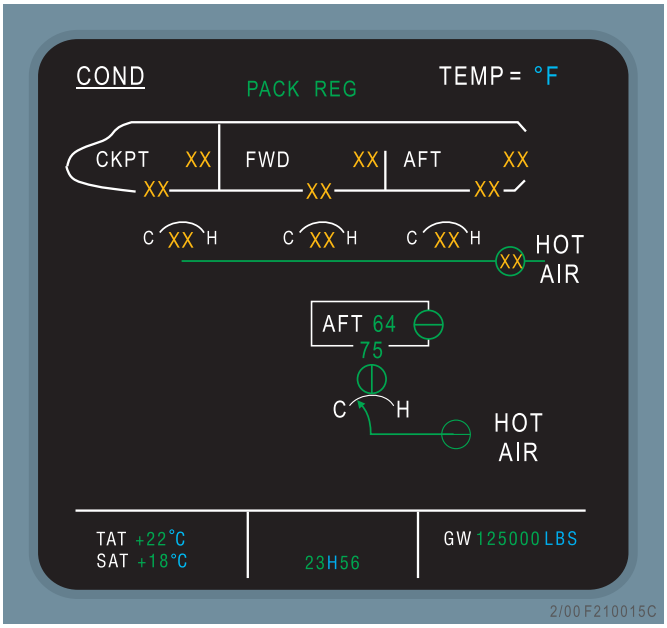
- The secondary channel operates as backup.
- On the ECAM COND page the message ALTN MODE appears in green.
- A slight degradation of air conditioning capability will be experienced.

If the zone regulator experiences a failure of only the secondary channel, there will be no effect on temperature regulation. Amber “XX” appears on the ECAM COND system display page where system data is not available.

If the zone regulator experiences failure of both primary and secondary channels, a further degradation of air conditioning capability will be experienced. The message PACK REG appears in green on the AIR COND system page.



Zone Regulator Primary Channel Failed



Zone Regulator Primary and Secondary Channels Failed

Note: When a zone regulator primary channel failure occurs the temperature selectors and flow selector on the AIR COND control panel will be inoperative.

Air Conditioning Faults (continued)

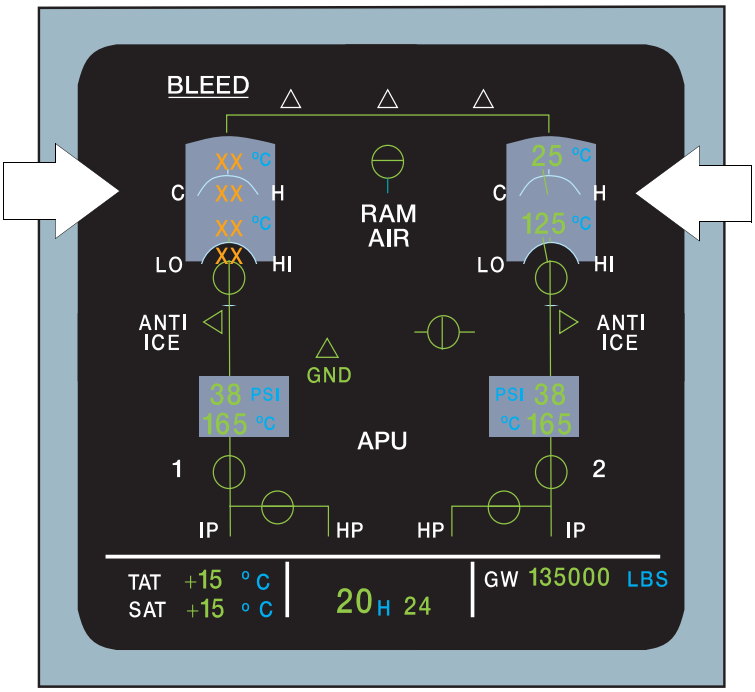
Pack Regulator Faults

If a pack regulator experiences failure of the primary channel, the following will occur:

- the secondary channel operates as a backup
- a slight degradation of air conditioning capability will be experienced

If a pack regulator experiences failure of only the secondary channel, there will be no affect of pack regulation. The ECAM BLEED page indications related to that pack will be replaced with amber “XX”.

Pack Regulator Secondary Channel Fault or Primary and Secondary Channels Fault



Normal Indications

FG21015C

If a pack regulator experiences failure of both the primary and the secondary channels, the following events occur:

- the corresponding pack outlet temperature will be regulated to 15°C (60°F).
- ECAM BLEED page indications related to the corresponding pack will be replaced with amber XX.

Air Conditioning Faults (continued)

Hot Air Valve Failure

If the valve fails in the open position, it will have no effect on the system.

If the valve fails in the closed position, individual zone temperature control is lost.

Trim Air Valve Failure

If the trim air valves fail, the zone regulator will go to its backup mode as temperature optimization will be lost.

If only one trim air valve fails, the zone controller will operate normally. However, the temperature in that zone may become excessively cold or hot. If this occurs, selecting the HOT AIR pb off allows the flight deck and cabin temperature to be controlled by regulating pack output. The COCKPIT selector will control the output of pack 1, and pack 2 output is an average of the FWD and AFT cabin selectors.

Pressurization Overview

Overview

The A319/320 pressurization system is fully automatic and provides pressurization control for:

- the flight deck,
- the cabin,
- the avionics bay, and
- the cargo compartments.

The system consists of:

- two controllers,
- one outflow valve,
- two safety valves, and
- one control panel.

Pressurization Components

Pressurization Controllers

The automatic mode of the pressurization system consists of two independent operating pressurization controllers (computers), designated as SYS 1(2). When in the automatic mode, only one system is active while the other is in a standby mode. Following each landing, the active controller is automatically deseleted and the standby controller becomes active.

Pressurization controllers simultaneously receive atmospheric and aircraft operating data from several sources, including the Air Data Inertial Reference System (ADIRS), and the Flight Management and Guidance System (FMGS).

The automatic mode actively controls and maintains the appropriate cabin pressurization requirement throughout the entire flight profile starting when takeoff power has been selected.

If the active controller fails, the other controller will take over automatically. If degraded pressurization controller performance is suspected, manual switching to the standby controller is accomplished by selecting the MODE SEL pb to MAN for 10 seconds and then return the pb to AUTO (lights out). If both controllers fail the manual mode of operation must be manually selected.

For operation in the manual mode, the previously active controller has a backup section that provides ECAM indications and warnings.

Pressurization Components (continued)

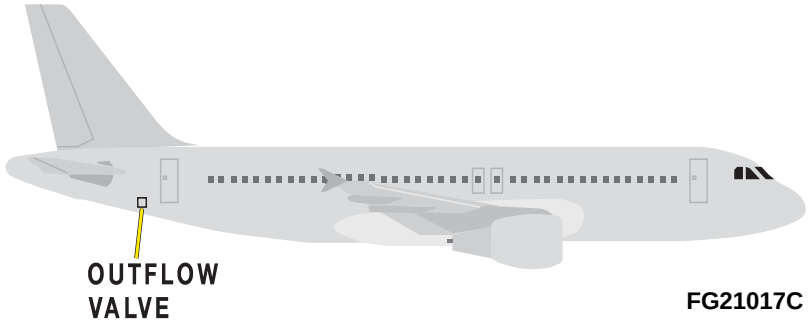
Outflow Valve

The outflow valve is located on the right side of the fuselage, behind the aft cargo compartment and below the flotation line.

The outflow valve actuator can be driven by either of two automatic motors or by a manual motor. Each automatic motor is associated with one of the pressure controllers.

Normally, the control of the outflow valve for pressurization is fully automatic. However, the outflow valve may be controlled manually. When operating in the automatic mode the outflow valve position is transmitted to the ECAM via the operating controller. In the manual mode the valve position signal is transmitted via the backup section of pressure controller number one.

When the RAM AIR pb is selected on, the outflow valve automatically opens when the pressure differential is less than 1 psi.



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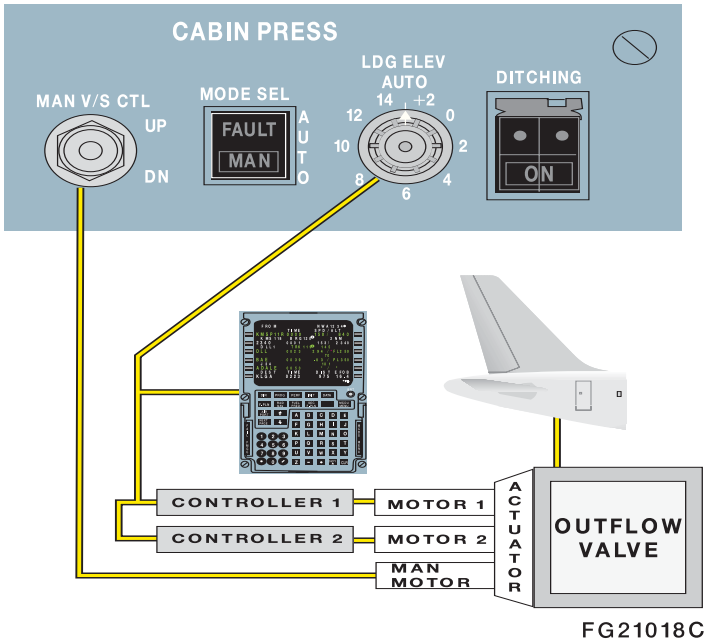

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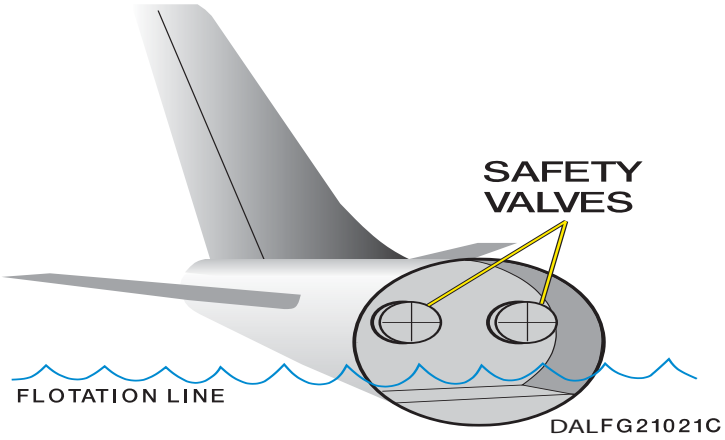
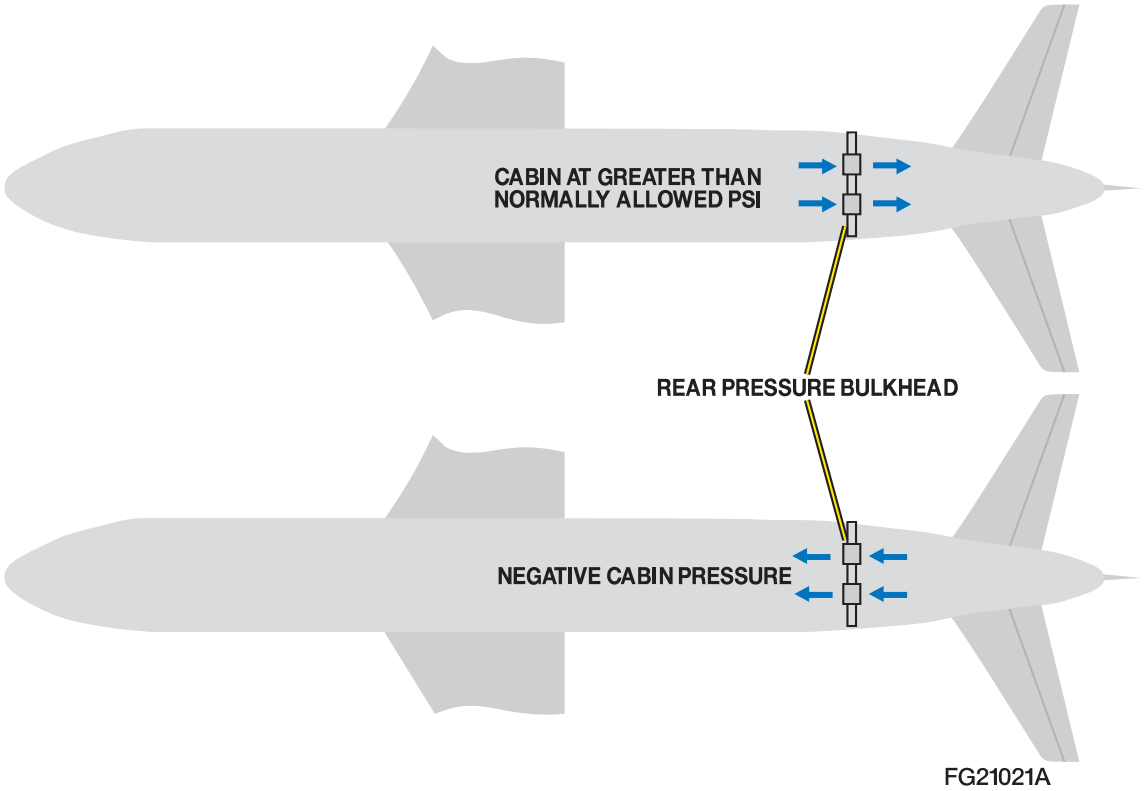
Pressurization Components (continued)

Safety Valves

Two independent safety valves prevent excessive positive or negative differential pressure. They are pneumatically actuated and are located on the rear pressure bulkhead above the flotation line. Their position is displayed on the ECAM CAB PRESS page. There are no flight deck controls for the safety valves.





Pressurization Components (continued)

Automatic Pressure Control Mode

One of the two pressure controllers normally operates the outflow valve via one of the automatic motors. Only one controller can operate at a time, and they alternate at each landing. If a controller failure occurs, the other controller will automatically become active.

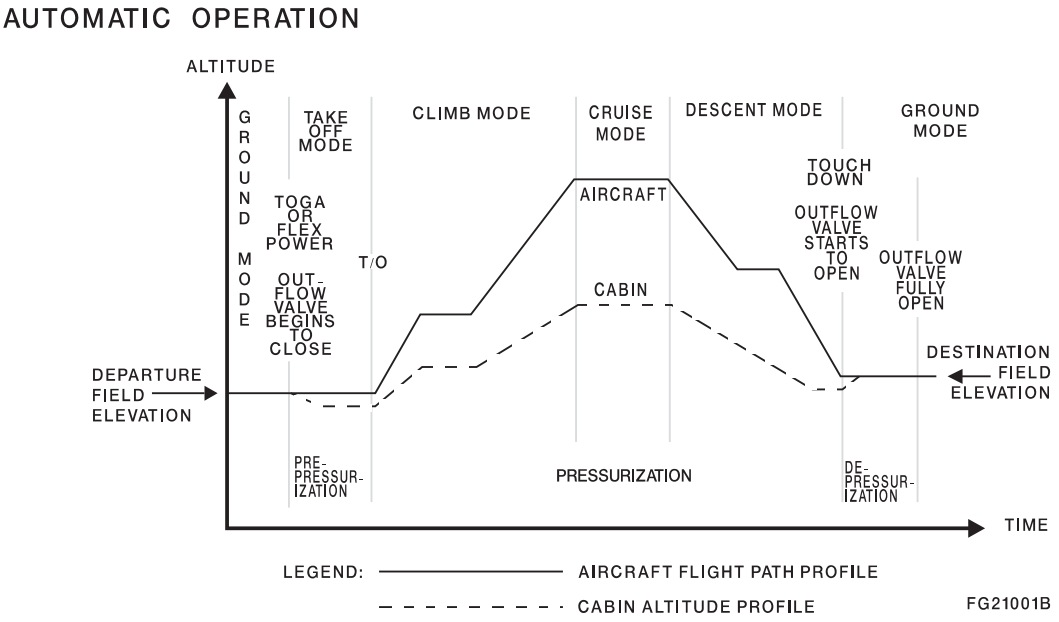
There are six pressurization modes when the airplane is functioning automatically:

- **Ground** - The ground function ensures that the aircraft is depressurized by opening the outflow valve fully during ground operations.
- **Takeoff** - To avoid a pressure surge at rotation, the takeoff mode causes the controller to prepressurize the aircraft prior to lift-off.
- **Climb** - The climb mode begins at lift-off, and the pressure controller will vary the cabin altitude with the actual aircraft climb rate.
- **Cruise** - During cruise the pressure controller will maintain the minimum cabin altitude that is compatible with the maximum allowable differential pressure. However, during flights of short duration the controller will maintain the cabin altitude at the landing field elevation if the landing field elevation exceeds the normal cabin altitude at level off.
- **Descent** - During descent the pressure controller will optimize the cabin descent to reach an altitude slightly below the landing field pressure altitude just prior to landing. The FMS destination airport elevation and QNH entries will normally determine the pressurization target altitude. If this is not available, the pilot must manually select the landing elevation.

  During descent, the cabin descent rate will not exceed a pre-determined limit. After landing the residual cabin pressure is released gradually before the outflow valve is fully opened. A full open signal is sent to the outflow valve shortly after touchdown.
- **Abort** - In the event the flight returns to the departure airport, the cabin altitude will automatically return to the departure field elevation.

Pressurization Components (continued)

Automatic Pressure Control Mode (continued)

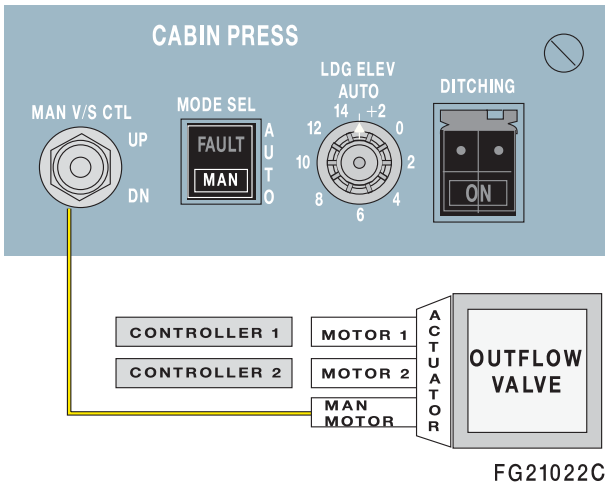


Manual Pressure Control Mode

In the event both pressure controllers fail, the pressurization system can be controlled by operating the outflow valve manually. The manual pressurization mode is activated by selecting the MAN position on the MODE SEL pb.

In the manual mode, the outflow valve is positioned by a dedicated manual motor which is controlled by the UP or DN positions of the MAN V/S CTL switch.

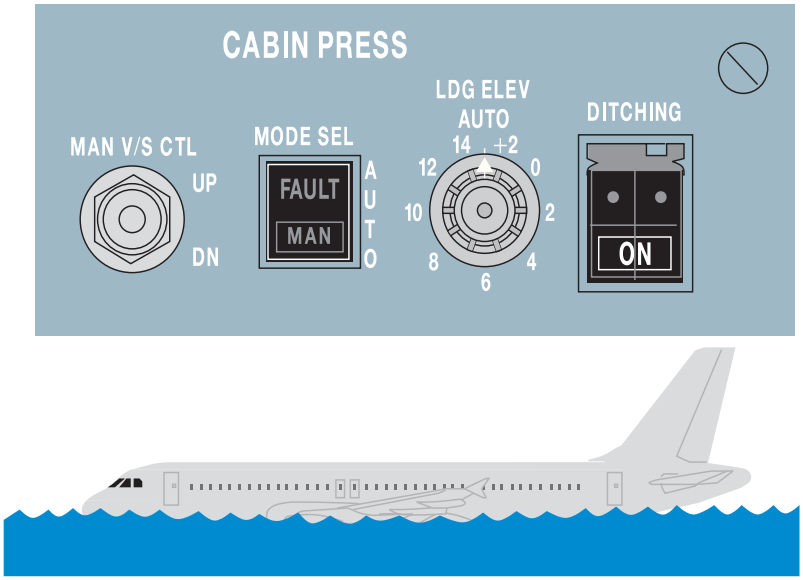
Note: If degraded pressurization controller performance is suspected, manual switching to the standby controller is accomplished by selecting the MODE SEL pb to MAN for 10 seconds and then returning the pb to AUTO (light out).



Pressurization Components (continued)

Ditching

Selecting the DITCHING pb ON causes all the openings on the exterior of the aircraft below the flotation line to close.



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Note: The outflow valve will not automatically close when the DITCHING pb is selected ON if the pressurization system is operating in the manual mode.

Ventilation Overview

Overview

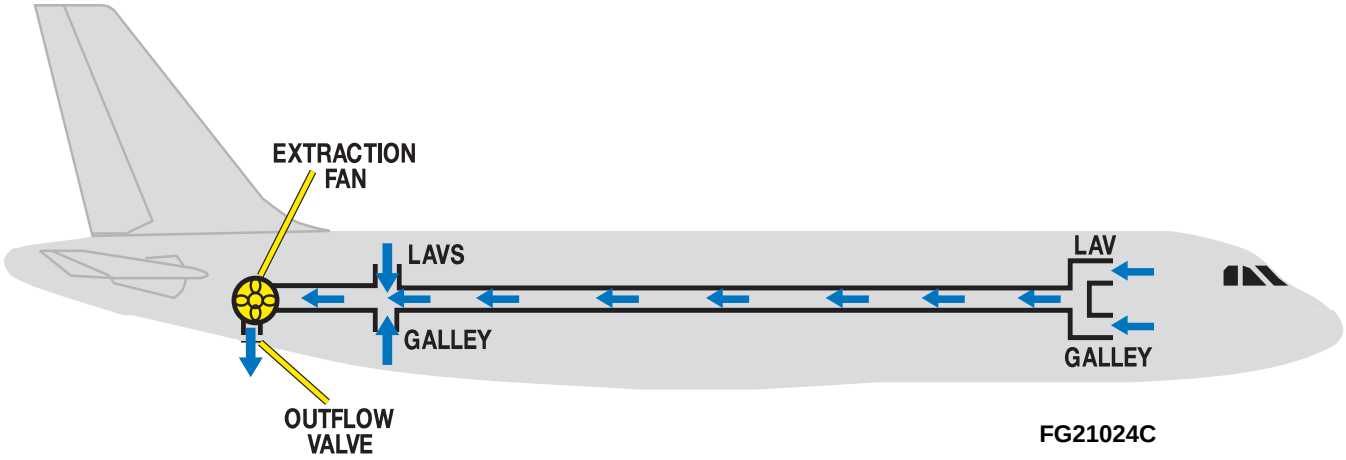
The A319/320 ventilation system provides ventilation to:

- the cockpit and cabin,
- the aft cargo compartment,
- the lavatories and galleys,
- the batteries, and
- the avionics equipment.

Ventilation

Lavatory and Galley Ventilation

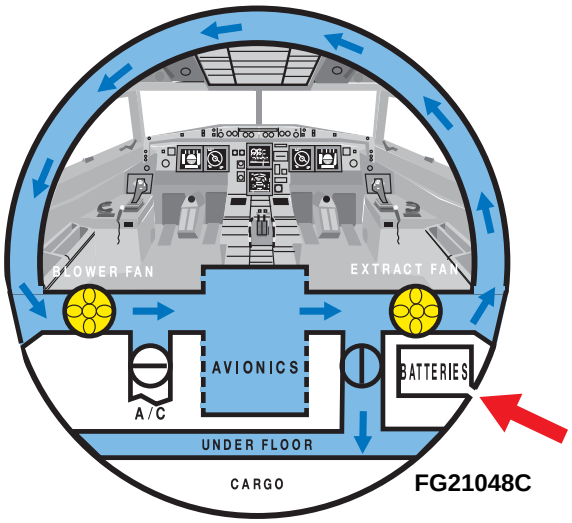
The lavatories and galleys are ventilated with cabin air. This ventilation is controlled by the extraction fan which pulls air into an extraction duct and then exhausts it overboard. The extraction fan runs continuously when electrical power is available.



FG21024C

Battery Ventilation

Battery ventilation is achieved by drawing ambient air around the batteries and then venting it directly overboard through a venturi in the aircraft skin.



FG21048C

FWD CARGO Compartment

The FWD cargo compartment is a class “D” fire area and is not heated or ventilated. The FWD cargo area does receive passive heat from the air that surrounds the outside of the FWD cargo bin from the avionics cooling system. This passive heat is generally enough to keep the FWD compartment well above freezing temperature.

Normal Avionics Ventilation Configurations

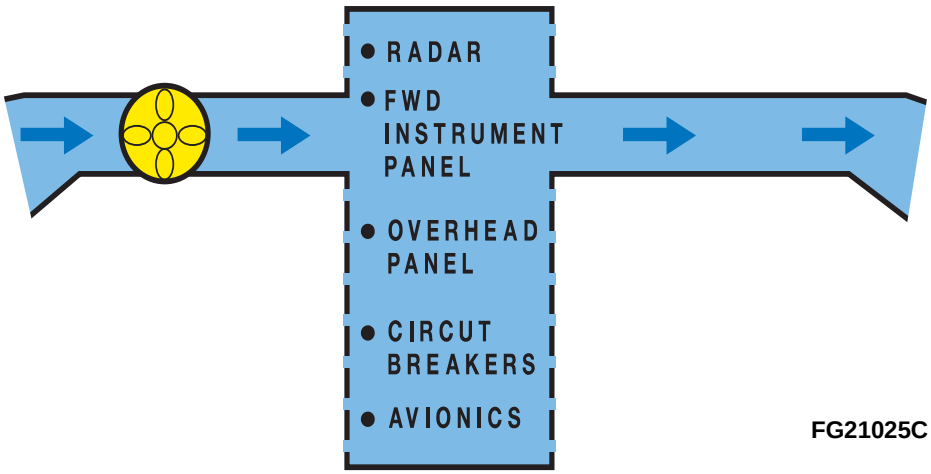
Avionics Ventilation System Components

Main components of the avionics ventilation system are:

- one digital ventilation controller,
- two electric fans,
- one air inlet valve,
- one three-position air extract valve,
- an aircraft skin heat exchanger, and
- additional automatic control valves.

The ventilation controller allows avionics ventilation to be fully automatic. Air is circulated by a blower and an extract fan which operates continuously as long as the aircraft electrical system is supplied.

The avionics ventilation system provides cooling of components within the electronics bay as well as those in the flight deck including the instrument and circuit breaker panels.



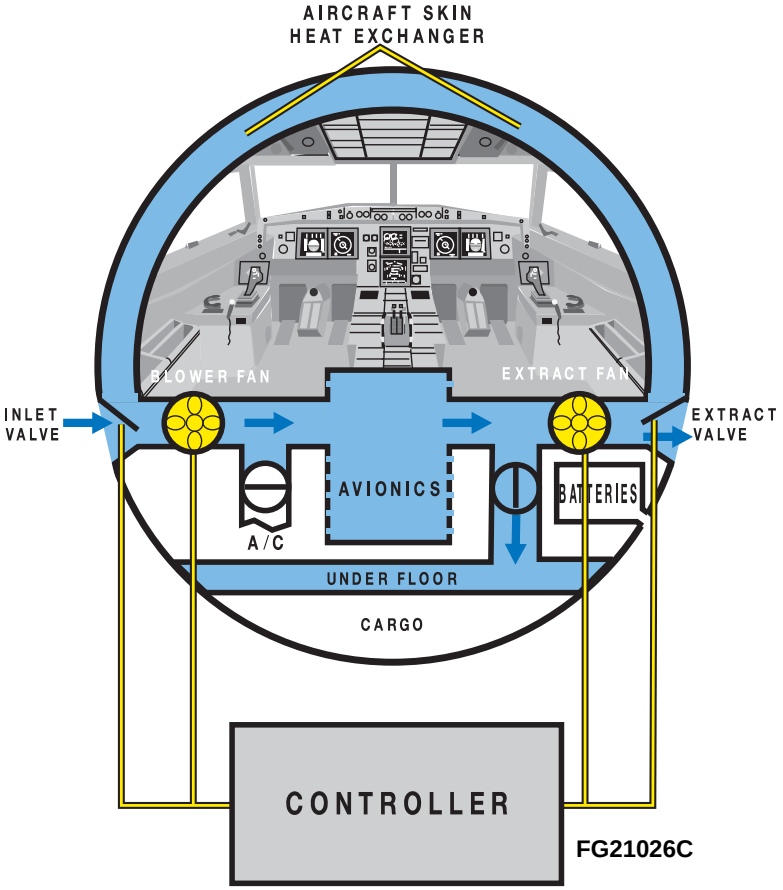
FG21025C

Normal Avionics Ventilation Configurations (continued)

Overview

The logic provided by the controller automatically selects one of three ventilation configurations depending on the phase of operation and the outside air temperature. Depending on whether the aircraft is on the ground or in flight and the outside air temperature, the system can be open, closed, or in the intermediate configuration.

Open, closed, and intermediate refer to the inlet and extract valve configuration. These valves are located on the aircraft fuselage. The inlet valve is on the left forward fuselage and the extract is on the right forward fuselage.



FG21026C

In Flight

The normal configuration in flight is the closed configuration. If warm ambient temperatures exist in flight, the system can be ventilated in the intermediate configuration.

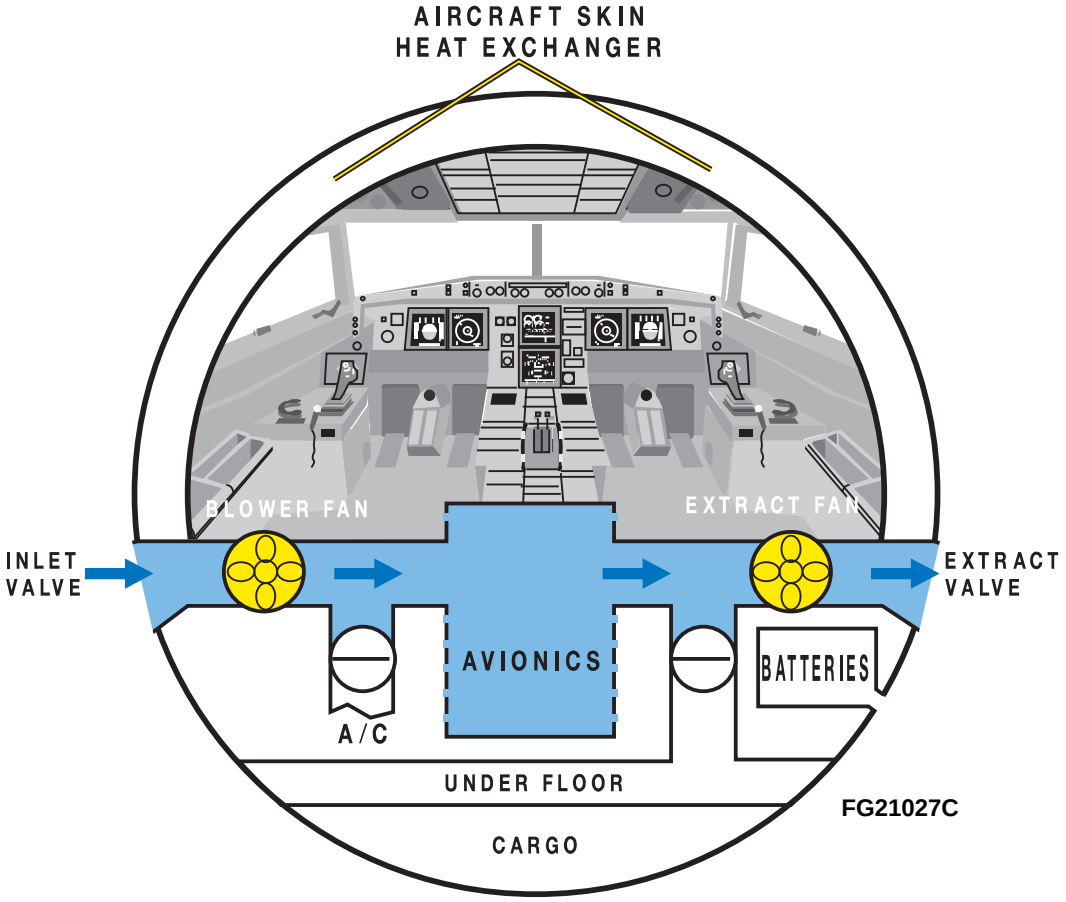
On the Ground

On the ground, the avionics are ventilated by circulating outside air when warm ambient conditions exist (open configuration). Otherwise, the system uses the closed configuration.

Normal Avionics Ventilation Configurations (continued)

Open Configuration

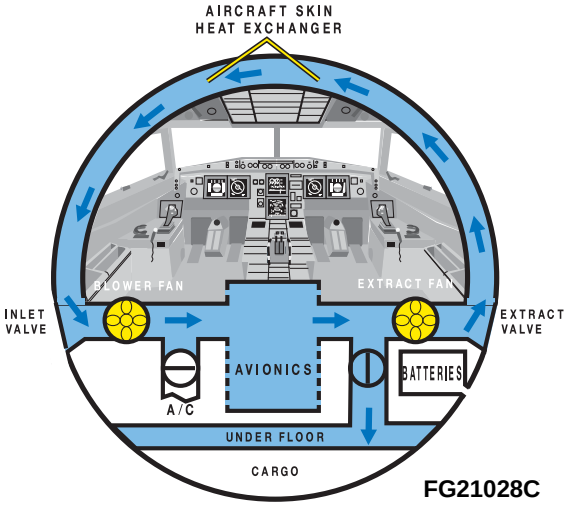
The avionics ventilation system is in the open configuration on the ground when warm ambient conditions exist. Outside air is drawn through the inlet valve by the blower fan, and after passing around the equipment, the air is extracted overboard through the fully open extract valve.



Normal Avionics Ventilation Configurations (continued)

Closed Configuration

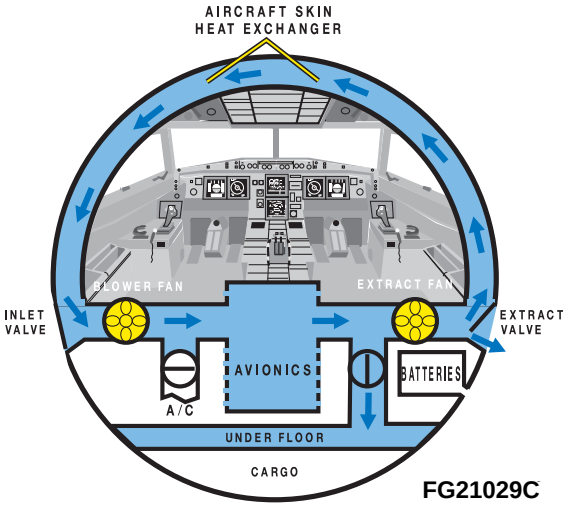
The avionics ventilation system is in the closed configuration on the ground when cold ambient conditions exist. It is also the normal configuration in flight. The extract fan draws recirculated air through and around the avionics equipment. The air then passes through a skin heat exchanger and a filter before reentering the circuit through the blower fan. Some air is expelled from the system through the cargo under floor.



FG21028C

Intermediate Configuration

The avionics ventilation system is in the intermediate configuration when warm ambient conditions exist in flight. (In flight is defined as anytime after the application of takeoff thrust on the ground or any time while airborne). It is similar to the closed configuration, except that a small internal flap on the extract valve opens to exhaust some of the heated air overboard.

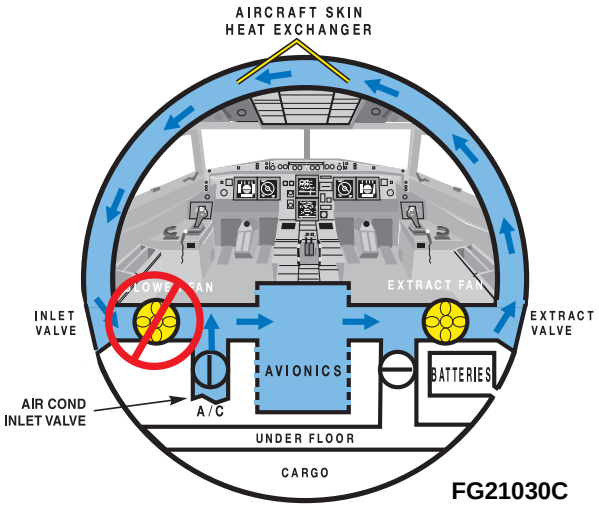


FG21029C

Abnormal Avionics Ventilation Configurations

Blower Fault

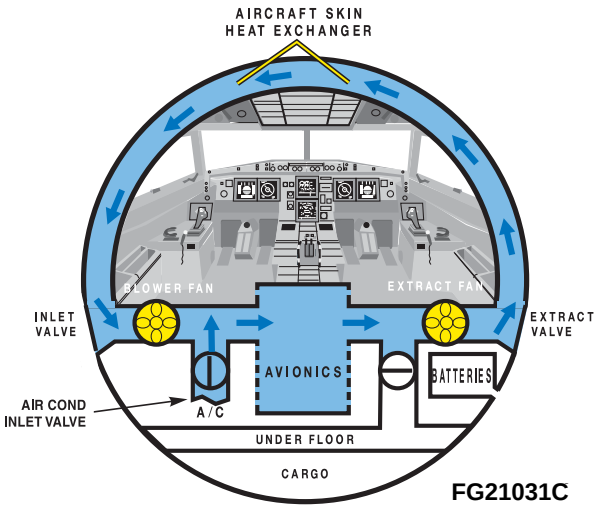
If a blower fan fault is detected the avionics ventilation will operate in the closed configuration. The blower fan will stop and air conditioned air will be added to the recirculated air. The ECAM will provide instructions for the pilot to reconfigure the system.



FG21030C

Extract Fault

If an extract fan fault is detected the avionics will operate in the closed configuration. The ECAM will provide instructions for the pilot to reconfigure the system, however, the extract fan continues to operate and air conditioned air will be added to the recirculated air, similar to a blower fault.

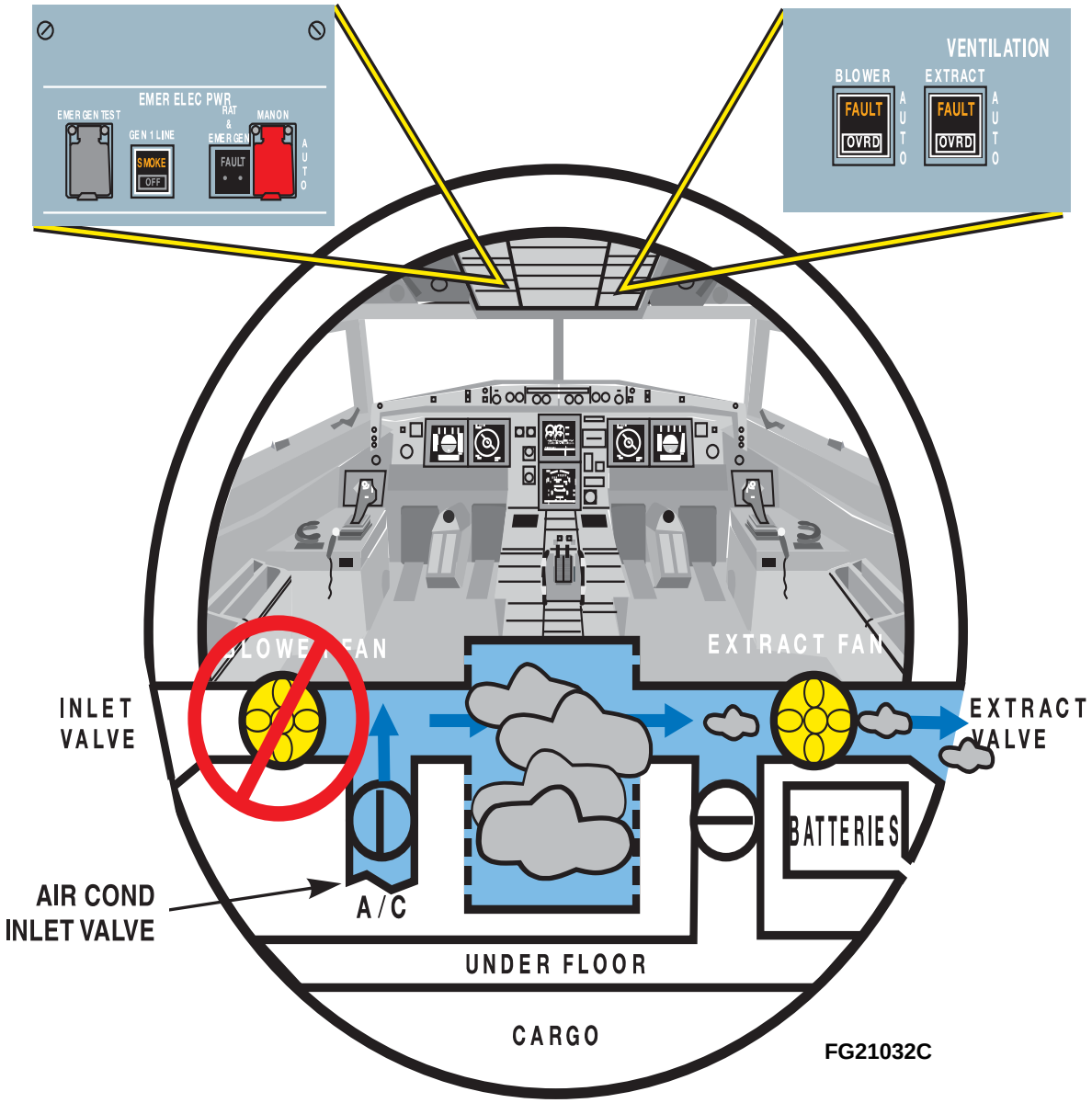


FG21031C

Abnormal Avionics Ventilation Configurations (continued)

Smoke Configuration

If smoke is detected in the avionics ventilation duct, the BLOWER and EXTRACT pb FAULT lights illuminate and the SMOKE light illuminates on the EMER ELEC PWR panel. Selecting both the BLOWER and EXTRACT pbs to OVRD will place the avionics ventilation system in the smoke configuration. In this case, additional air is provided by the air conditioning system and extracted overboard. The blower fan will not operate in this configuration. However, the extract fan will continue to run. The skin heat exchanger is bypassed.



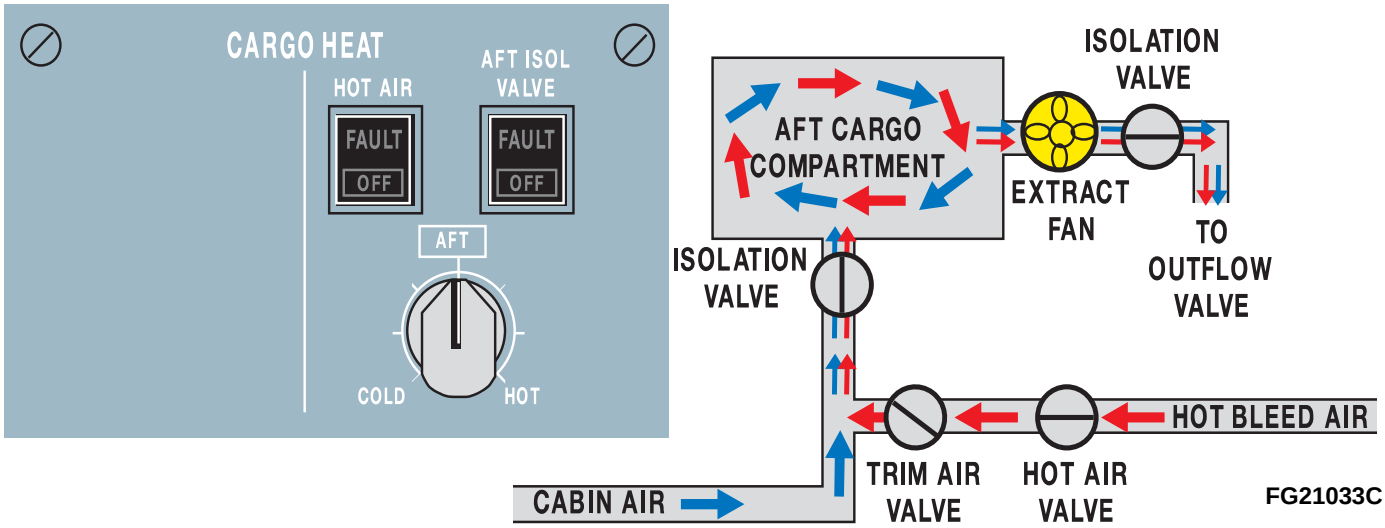
Ventilation Controller Fault

In the event of a ventilation controller fault, the inlet valve and aircraft skin heat exchanger control valves remain in the position that they were in prior to the failure.

Aft Cargo Compartment Ventilation and Heating

Overview

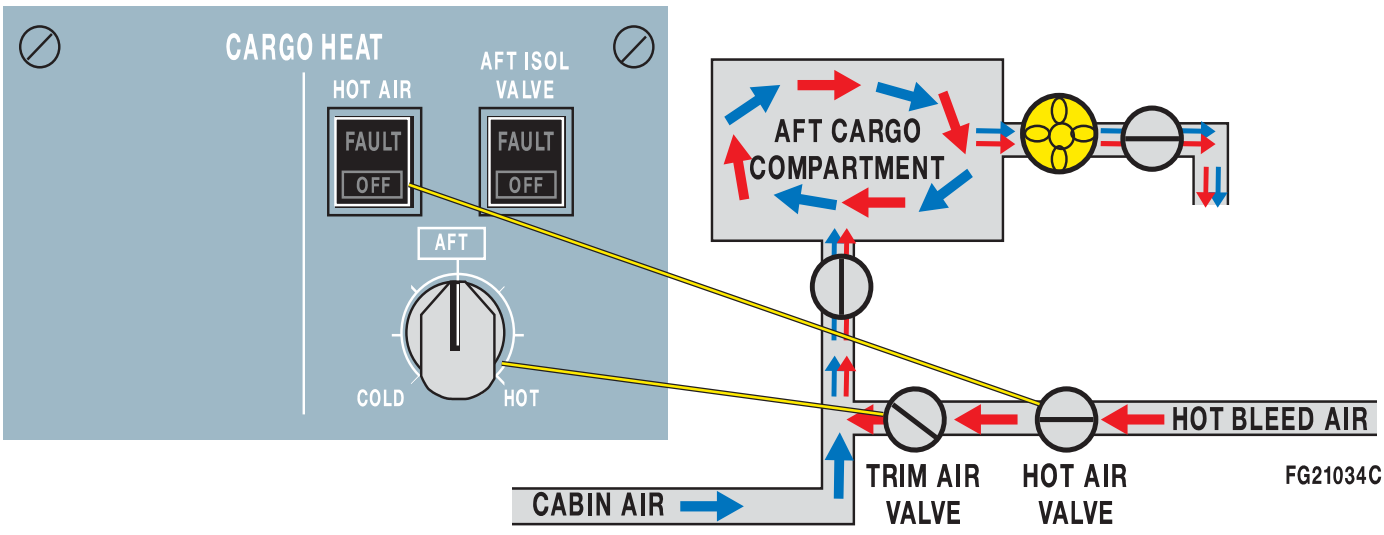
Operation of the aft cargo ventilation and heating system is entirely automatic. Airflow for the cargo compartment is drawn from the passenger cabin. A cargo extract fan pulls air from the cabin through the aft cargo compartment and dumps it overboard through the outflow valve.



Trim Air System

A trim air system is installed to allow control of the aft cargo compartment temperature.

Hot bleed air flows through a hot air valve to the trim air valve. Computer logic to the trim air valve controls how much hot air is added to the airflow to maintain the selected compartment temperature.

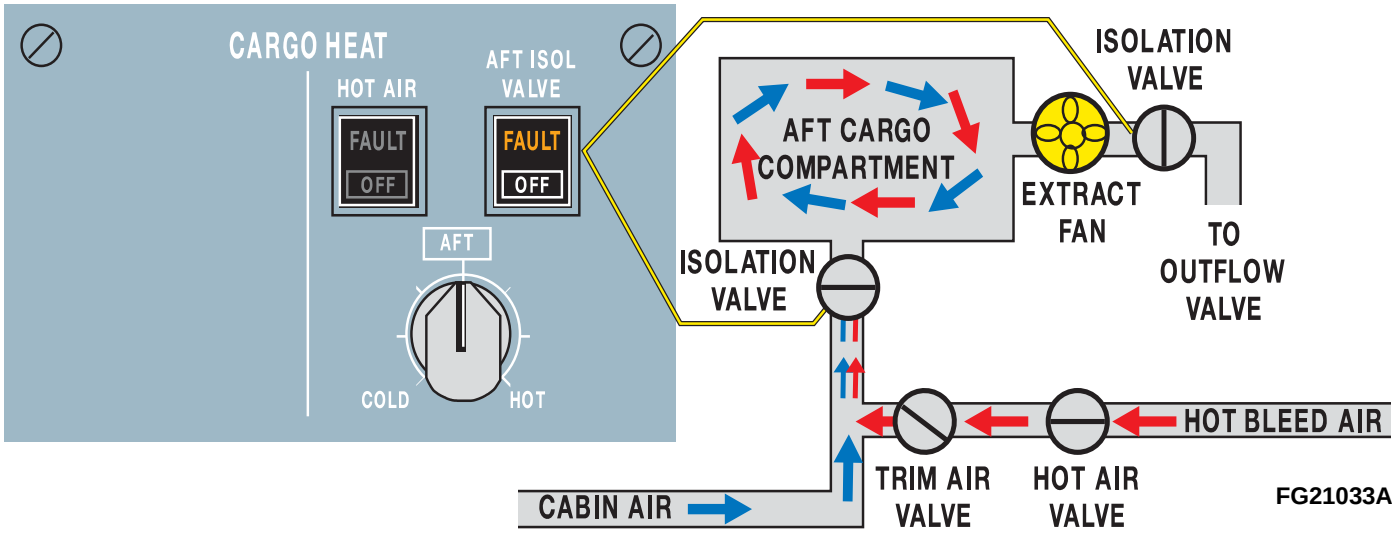


Aft Cargo Compartment Ventilation and Heating (continued)

Isolation Valves

The cargo ventilation system includes an isolation valve before and after the cargo compartment. These valves can be closed from the flight deck. They close automatically if smoke is detected.

When the isolation valves are closed, the cargo extract fan stops.



Smoke Detection

Smoke detection in the aft cargo compartment is provided by four smoke detectors which are controlled by the Smoke Detection Control Unit (SDCU). Refer to chapter 26, Fire Protection, for additional information.

Cargo Ventilation Controller

Cargo ventilation is fully automatic. The cargo ventilation controller will automatically close the isolation valves and stop the extraction fan in the event smoke is detected.

Cargo Heating Controller

The cargo heating controller protects the compartment from an overheat condition by monitoring the air inlet temperature. If the temperature exceeds a predetermined threshold the controller will close the hot air pressure regulating valve. The system may be reset via the HOT AIR pb when the temperature cools below the threshold.

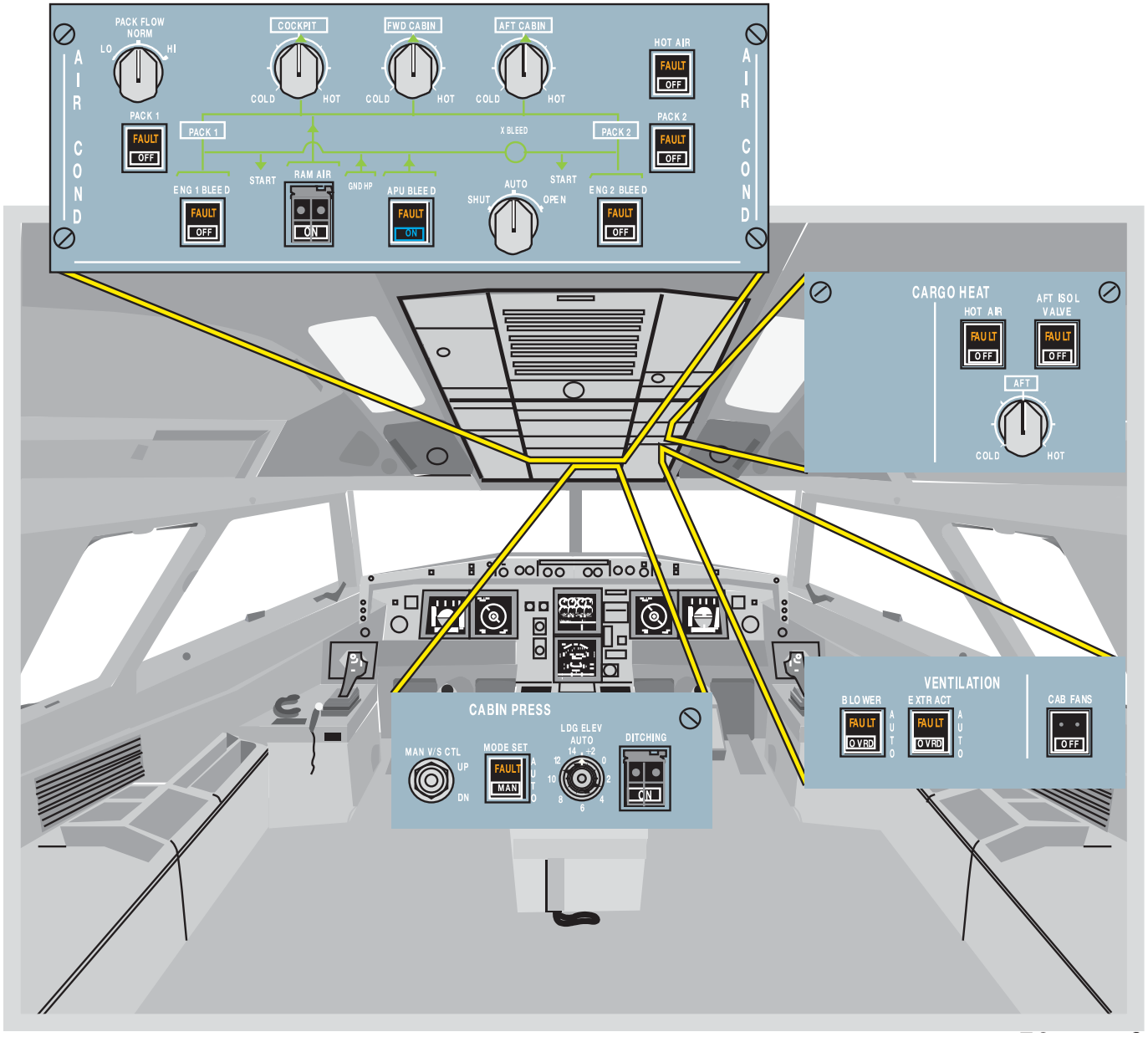
Intentionally Left Blank

Controls and Indicators

Location of Controls and Indicators

Location

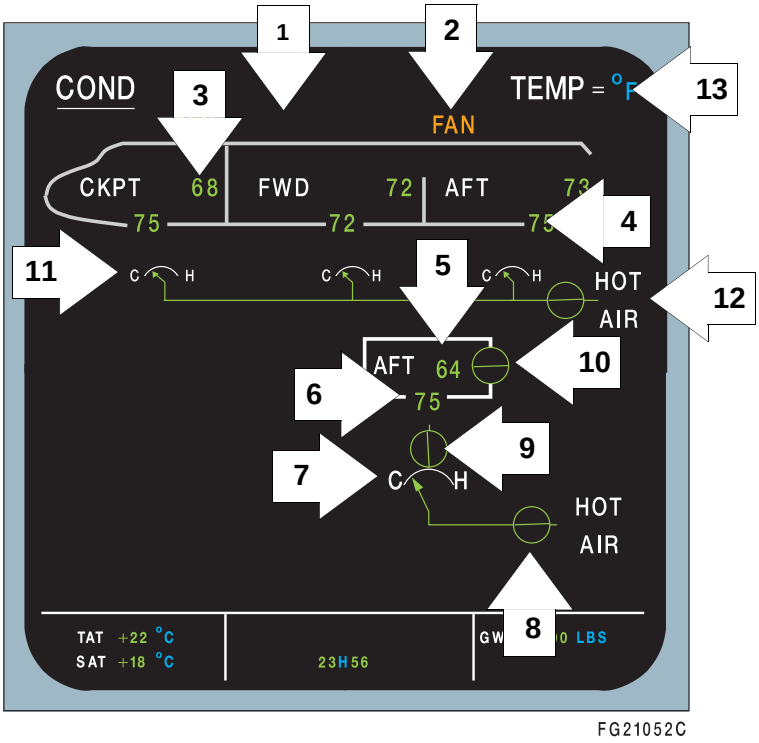
The air conditioning, pressurization, and ventilation system controls and indicators located in the flight deck are shown below.



FG21035C

ECAM COND Page

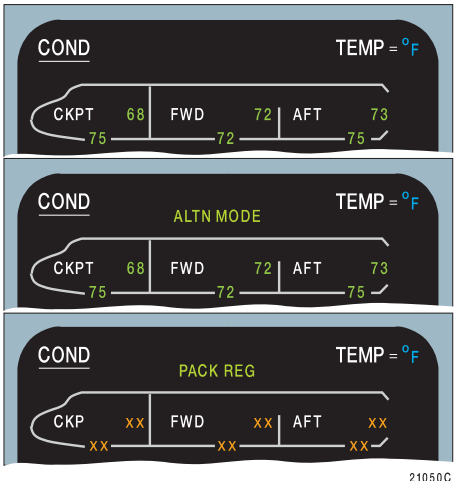
Display



FG21052C

1. Zone Regulator Fault Indication

When the zone regulator is operating normally, this area is blank.



21050C

Normal

Zone Regulator Primary Channel Failure

Zone Regulator Primary and Secondary Channels Failure

If the zone regulator experiences a primary channel fault, ALTN MODE appears in green.

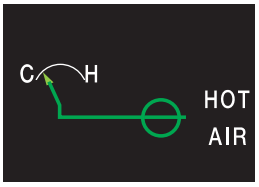
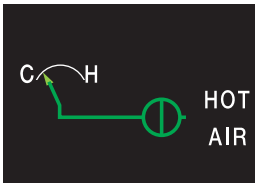
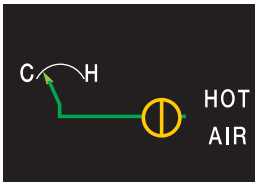
If the zone regulator experiences a primary and secondary channel fault PACK REG appears in green.

ECAM COND Page (continued)

2. Cabin Fan Fault Indication	If a cabin fan fault is detected, “FAN” appears in amber.
3. Zone Temperature	The temperature of each individual air conditioning zone is shown in green.
4. Zone Duct Temperature	The temperature in the air conditioning duct for each zone is shown in green. If the temperature exceeds the threshold for a duct overheat, the indication changes to amber.
5. Aft Cargo Compartment Temperature	The temperature of the aft cargo compartment is indicated in green.
6. Aft Cargo Compartment Duct Inlet Temperature	The temperature in the air conditioning duct for the aft cargo compartment is shown in green. If the temperature exceeds the threshold for a duct overheat, the indication turns amber.
7. Aft Cargo Trim Air Valve	The position of the aft cargo compartment trim air valve is shown in green. The valve ranges from the full closed position (C) to the full open position (H).

ECAM COND Page (continued)

8. Aft Cargo Hot Air Valve

Condition	Indication
A horizontal green line indicates that the hot air valve is open.	
An amber horizontal line indicates that the hot air valve has failed open.	
A green vertical line indicates that the hot air valve is closed and the HOT AIR pb is selected ON.	
An amber vertical line indicates the hot air valve has failed closed or that the HOT AIR pb is selected OFF.	

FG21037C

9. Aft Cargo Inlet Isolation Valve

A green vertical line indicates that the aft cargo inlet isolation valve is open.

An amber horizontal line, indicates the valve is closed due to the AFT ISOL VALVE pb being selected OFF.

CLOSED POSITION

OPEN POSITION

FG21036C

ECAM COND Page (continued)

10. Aft Cargo Outlet Isolation Valve

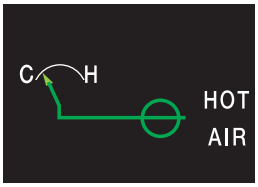
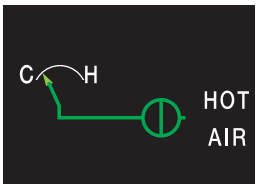
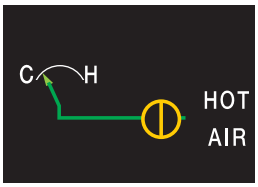
A green horizontal line indicates that the aft cargo outlet isolation valve is open.

An amber vertical line indicates that the aft cargo outlet isolation valve is closed, due to the AFT ISOL Valve pb being selected OFF.

11. Zone Trim Air Valve Position

The position of each trim valve is shown in green and ranges from the full closed position (C) to the full open position (H).

12. Hot Air Valve Position

Condition	Indication
A horizontal green line indicates that the hot air valve is open.	
With the valve open, an amber horizontal line indicates that the hot air valve and its controlling pb are in disagreement.	
A green vertical line indicates that the hot air valve is commanded closed with the HOT AIR pb is selected ON.	
An amber vertical line indicates the hot air valve is closed because the HOT AIR pb is selected off. It may also indicate that the valve is in disagreement with the position commanded by the zone regulator with the HOT AIR pb selected on (lights out).	

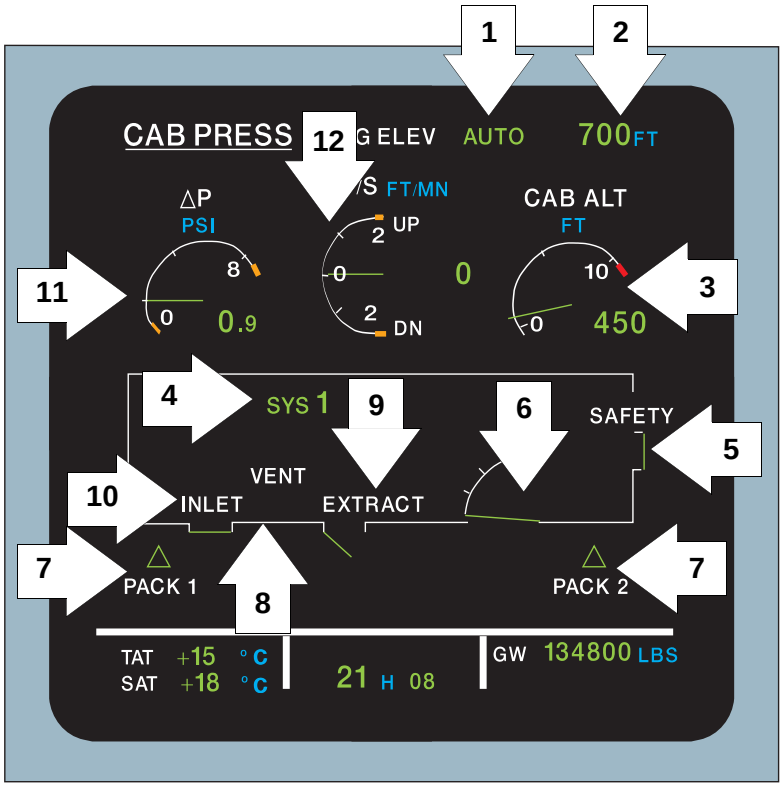
FG21037C

13. TEMP

The temperatures on the AIR COND page are measured in Fahrenheit.

ECAM CABIN PRESS Page

Display



FG21038C

1. Landing Elev AUTO/MAN Indication

When the pressurization system is being operated manually (MAN selected on MODE SEL pb) this area is blank.

When the pressurization system is operating automatically (MODE SEL pb to AUTO, lights out):

- AUTO is displayed in green when the LDG ELEV selector is in the AUTO position. Landing field elevation is supplied to pressurization controller by the FMGCs.
- MAN is displayed in green when the LDG ELEV selector is **not** in the AUTO position. The pilot manually selects field elevation that is supplied to the pressurization controller using the LDG ELEV selector.

2. Elevation Indication

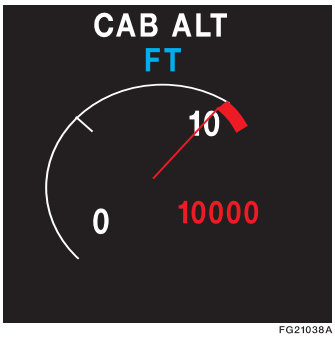
The landing elevation that is selected automatically by the FMGCs or manually by the pilot is indicated in green. This indication does not appear when the MODE SEL pb is in the MAN position.

ECAM CABIN PRESS Page (continued)

3. Cabin Altitude

Cabin altitude is shown on an arc indicator which incorporates a digital display in feet.

It normally appears green. If the cabin altitude reaches an advisory altitude the cabin altitude indication will begin to pulse in green. If the cabin altitude reaches approximately 10,000 feet the cabin altitude indication changes from green to red.



4. Active System Indication

When the pressurization is controlled automatically, the active pressure controller is indicated in green as either “SYS1” or “SYS2”.

If the active pressure controller experiences a fault the indication changes from green to amber.

When the MAN mode of pressurization is selected with the MODE SEL pb, “MAN” appears in green.

5. Safety Valve Position

The word SAFETY appears in white and the valve indication is green when both safety valves are fully closed.

The word SAFETY and the valve indication both change to amber when either safety valve is not closed.

ECAM CABIN PRESS Page (continued)

6. Outflow Valve Position

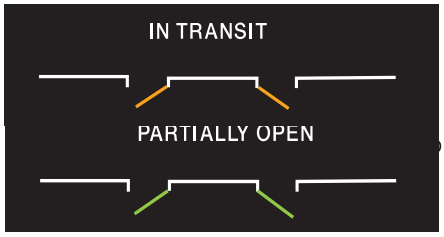
When operating normally, the outflow valve position indicator appears green.

The outflow valve position indicator changes to amber if the valve is fully open in flight.

7. Pack Indication

The triangles depict the pack flow control valve position. If the triangle is green the pack valve is open. If the pack valve is closed, the triangle and the label PACK 1 or PACK 2 changes to amber.

8. Avionics Inlet and Extract Valves Positions

Condition	Indication
Green horizontal lines indicate the valves are fully closed. If a disagreement exists between the actual valve position and the position commanded by the ventilation controller, the indication changes to amber.	FG21039A
Green horizontal lines indicate the valves are fully open. If a disagreement exists between the actual valve position and the position commanded by the ventilation controller, the indication changes to amber. **Note:** On the ground, depending on ambient temperature, the valves can be open and amber with no malfunction present.	FG21039B
Amber diagonal lines indicate the valves are in transit.	 FG21039C
Green diagonal lines indicate that the valves are partially open. They will normally appear green, but change to amber if the actual valve position disagrees with the position commanded by the ventilation controller.	
Amber XX appears amber when the valve has failed in transit.	FG21039E

ECAM CABIN PRESS Page (continued)

9. Inlet and Extract Valve Indications

The words INLET and EXTRACT will appear in white when the avionics ventilation system is operating normally.

If a blower fault or an extract fault occurs the corresponding indication will change to amber.

10. Vent Indication

The word VENT appears in white when the avionics ventilation system is operating normally.

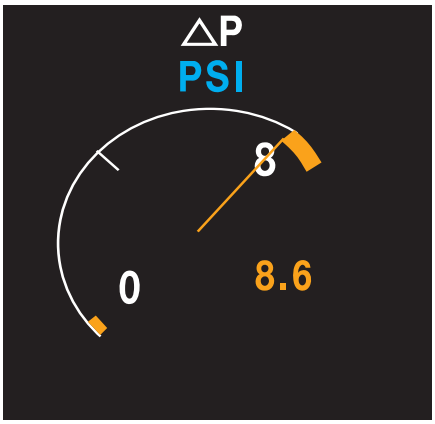
If a blower fault or an extract fault occurs, VENT changes to amber.

11. Cabin Differential Pressure

Cabin differential pressure (delta P) is shown on an arc indicator which incorporates a digital display. It normally appears green.

The delta P indication will begin to pulse in green if the differential pressure exceeds a predetermined limit while on approach.

If the cabin differential pressure is out of the normal range, the indication will change to amber.



FG21040C

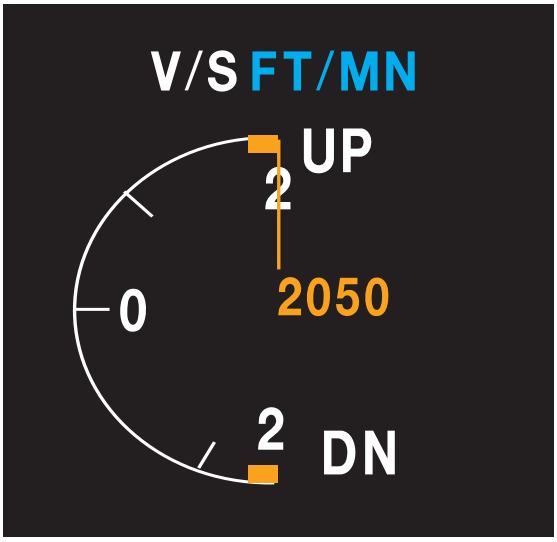
ECAM CABIN PRESS Page (continued)

12. Cabin Vertical Speed

The cabin vertical speed is shown on an arc indicator which incorporates a digital display in feet per minute. It normally appears green.

The cabin vertical speed indication will begin to pulse in green as it exceeds a safe rate of climb or descent.

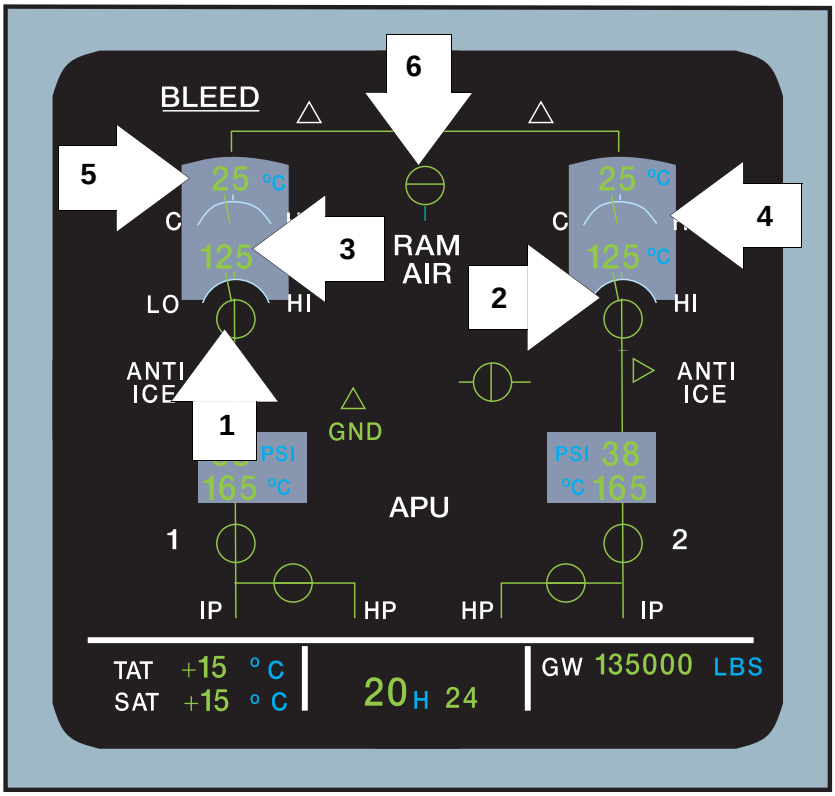
If the cabin vertical speed continues to increase into the advisory range, the indications will change from green to amber.



FG21051C

ECAM BLEED Page (Air Conditioning Related Items)

Display



FG21041C

1. Pack Flow Control Valve Position

A green vertical line indicates that the pack valve is not closed.

An amber vertical line indicates that the pack valve is not closed and in disagreement with its corresponding pb.

An amber diagonal line indicates the pack valve is in transit.

A green horizontal line indicates that the pack valve is fully closed.

An amber horizontal line indicates that the pack valve is fully closed and in disagreement with its corresponding pb.

2. Pack Flow

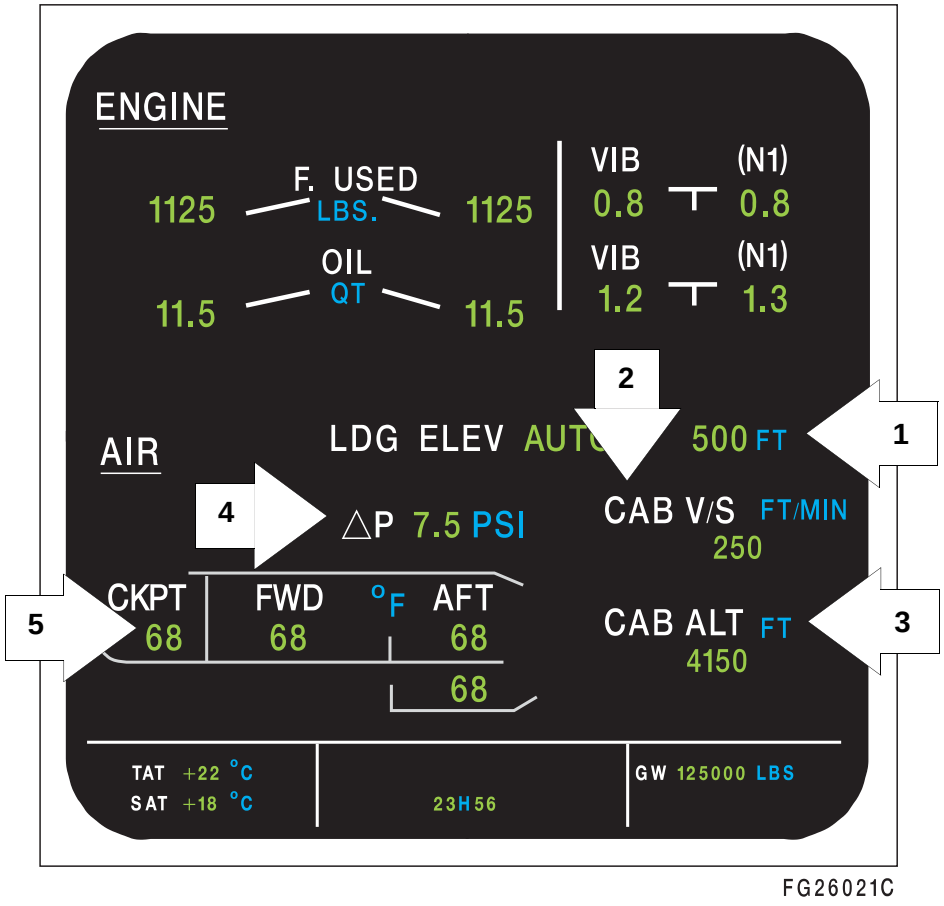
This arc indicator shows the pack flow volume from LO to HI. It is normally green but will change to amber if the pack flow control valve is closed.

ECAM BLEED Page (continued)

3. Pack Compressor Outlet Temperature	The pack compressor outlet temperature is normally displayed in green in degrees Celsius. The indication will change from green to amber if the temperature exceeds the advisory threshold.
4. Pack Bypass Valve Position	The arc indicator is always green and shows the position of the turbine bypass valve in the pack. The position ranges from fully closed (C) to fully open (H).
5. Pack Outlet Temperature	The pack outlet temperature is normally displayed in green, in degrees Celsius. The indication changes from green to amber if the temperature exceeds the advisory threshold.
6. RAM AIR Inlet Position	A green horizontal line indicates that the ram air inlet is fully closed. A green vertical line indicates that the ram air inlet is fully open in flight. An amber vertical line indicates that the ram air inlet is fully open on the ground. An amber slanted line indicates that the ram air inlet is in transit.

ECAM CRUISE Page (Air Conditioning Related Items)

Display



FG26021C

1. LDG ELEV

When AUTO is selected with the CAB PRESS MODE SEL pb and the LDG ELEV selector is in the AUTO position, the words LDG ELEV appears in white, the word AUTO and the landing elevation (in feet) selected by the FMGCs appears in green.

When the LDG ELEV selector is in a position other than AUTO the words LDG ELEV appear in white, the word MAN and the landing elevation (in feet) selected appears in green.

When MAN is selected with the CAB PRESS MODE SEL pb, this area is blank.

ECAM CRUISE System Page (continued)

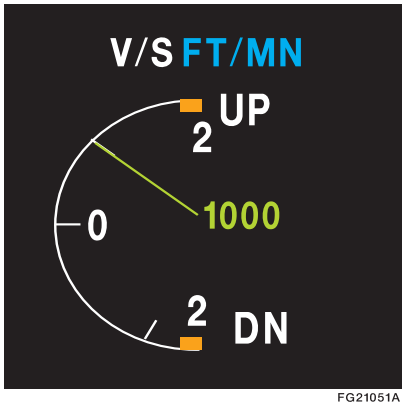
2. CAB V/S Indication

The cabin vertical speed will appear in green when in the normal range. If the vertical speed exceeds a safe climb or descent rate the indication will change to amber.

This is the indication when the pressurization is being operated in the automatic mode.

FG21049C

This is the indication when the pressurization is being operated manually.



FG21051A

3. CAB ALT Indication

The cabin altitude (in feet) normally appears in green. If the cabin altitude reaches approximately 10,000 ft, the indication changes to red.

4. Cabin Differential Pressure

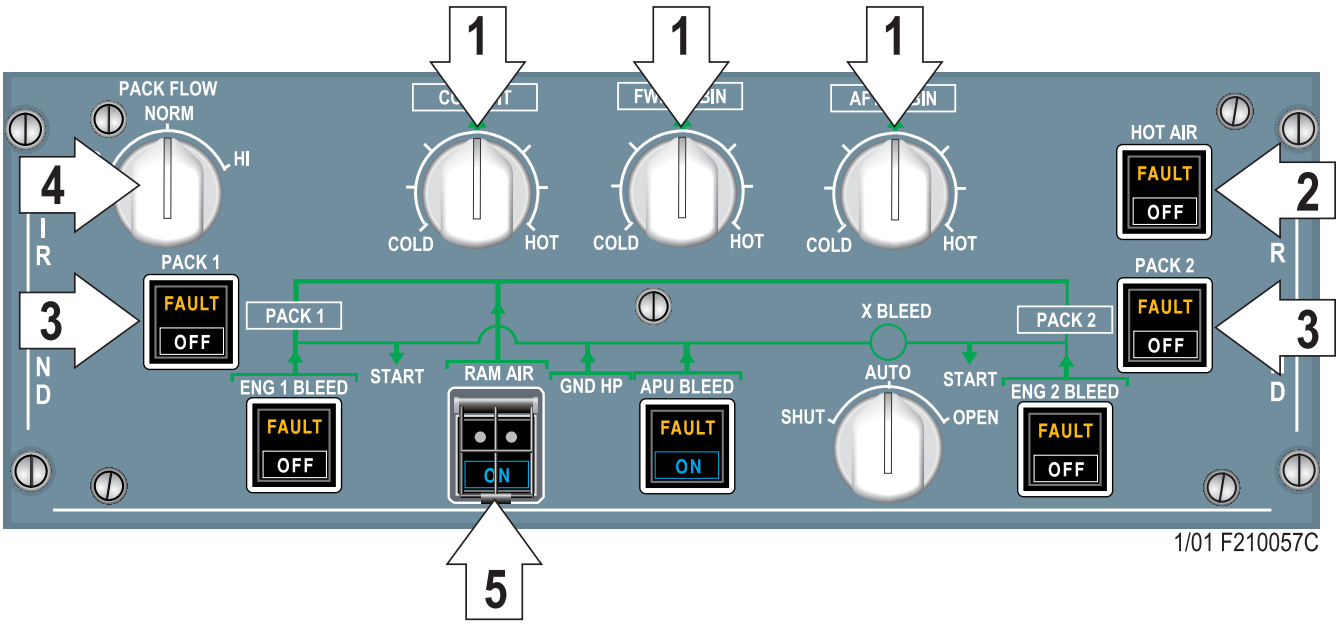
The cabin differential pressure (delta P) appears green when in the normal range. It appears amber when the differential pressure is out of the normal range.

5. Zone Indication and Temperature

The temperature, in Fahrenheit, in each zone is indicated.

AIR COND Panel

Function



1. Zone Temperature Selectors

The COCKPIT, FWD CABIN, and AFT CABIN selectors are used to adjust the temperatures in their respective zones. The temperature change request is sent to the zone regulator which then adjusts pack output and trim air valve positions to satisfy the pilot's input. When a selection to hotter or colder temperature has been made the change in zone temperate can be seen on the ECAM COND or CRUISE pages.

2. HOT AIR pb

ON

When selected on (lights out) the hot air valve regulates the pressure of the air in the hot air manifold.

OFF

When selected off, OFF illuminates white. The hot air valve moves to the full closed position and the trim air valves close due to the lack of air flow.

FAULT

When a duct overheat is detected, the hot air valve automatically closes, FAULT illuminates amber and an ECAM caution is generated. The FAULT light extinguishes when the duct temperature falls below the caution range and the hot air valve and pb are in agreement.

AIR COND Panel (continued)

3. PACK 1 (2) pb

The pack pb is used to select the pack on or off.

ON

When the pb is selected on, the pack flow control valve opens if ample bleed air is present. However, the pack valve will automatically close when:

- a fire pb is pushed,
- a pack overheat has been detected,
- engine start is initiated (for 30 seconds), or
- the ditching pb is selected on.

OFF

When the pb is selected off, the pack flow control valve closes. OFF illuminates white.

FAULT

When a disagreement between the actual and selected position of the pack flow control valve exists, FAULT illuminates amber, and an ECAM caution is generated.

If the FAULT light illuminates because of a disagreement caused by automatic closure due to a pack overheat, the FAULT light remains illuminated as long as the overheat conditions exists. If the pilot selects the PACK pb to OFF, the FAULT light extinguishes when the pack temperature drops back below a threshold. The pack flow control valve can then be reopened by selecting the PACK pb to on.

4. PACK FLOW Selector

This selector allows the pack volume flow to be varied manually. However, the zone controller normally regulates the pack flow automatically.

5. RAM AIR pb

This pb is used to open the emergency ram air inlet. In the normal position (lights out), the emergency ram air inlet is closed.

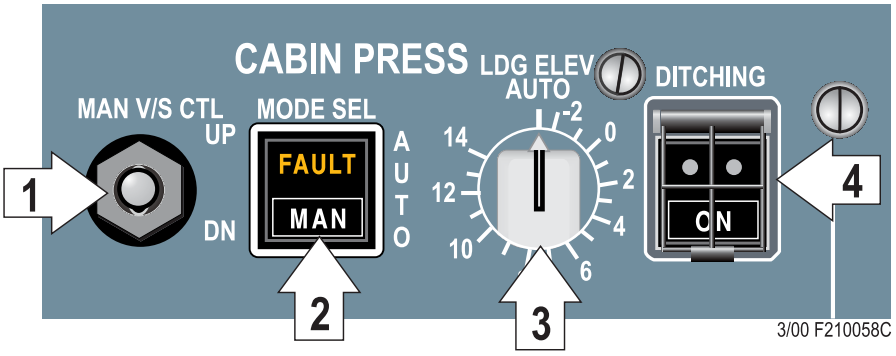
When the guard is lifted, and the pb depressed, ON illuminates blue, and the ram air inlet opens. RAM AIR ON is displayed in green on the E/WD display. Once the cabin differential pressure is less than 1 psi, the outflow valve will automatically open (if the cabin MODE SEL pb is in AUTO).

Note: The emergency ram air inlet and the outflow valve will not open if ditching has been selected.

CABIN PRESS Panel

Function

The function of the panel is to control the schedule of aircraft pressurization either automatically or manually. The DITCHING pb is also located on this panel.



1. MAN V/S CTL Switch

The toggle switch controls the outflow valve using the manual motor when MAN has been selected with the MODE SEL pb. This toggle switch is spring loaded to the center position.

UP
In the UP position the outflow valve opens.

DN
In the DN position the outflow valve closes.

2. MODE SEL pb

This pb is used to select manual or automatic control of the outflow valve.

AUTO
When the pb is in AUTO (lights out), the outflow valve is controlled by the active pressure controller and pressurization is fully automatic.

Note: If degraded pressurization performance is suspected, switching the active pressure controller can be accomplished by cycling the MODE SEL pb to MAN for at least 10 seconds and then back to AUTO.

MAN
When the pb is released out, MAN illuminates white and the FAULT light extinguishes, if previously lit. MAN allows the outflow valve to be operated manually by moving the MAN V/S CTL switch to UP or DN as necessary.

FAULT
When both pressure controllers have failed, FAULT illuminates amber and an ECAM caution is generated.

CABIN PRESS Panel (continued)

3. LDG ELEV Selector

The selector enables the pilot to select the auto or manual mode of determining the landing field elevation for the pressurization computers. The manual mode is used when the FMGCs are inoperative or the airport of intended landing is not in the database.

AUTO

When in the AUTO, or 12 o'clock position, the pressurization system uses FMGC data to determine landing field pressure altitude.

-2000 to 14,000

When the selector is in any position other than 12 o'clock, the landing elevation that is selected, from -2,000 to 14,000 ft, will be used as a reference in determining the pressurization profile.

MAN LDG ELEV is displayed on the ECAM memo in green if the LDG ELEV selector is not in the AUTO (12 o'clock) position.

4. DITCHING pb

In its normal guarded position, DITCHING is not selected.

When the pb is selected, ON illuminates white and the following will automatically close:

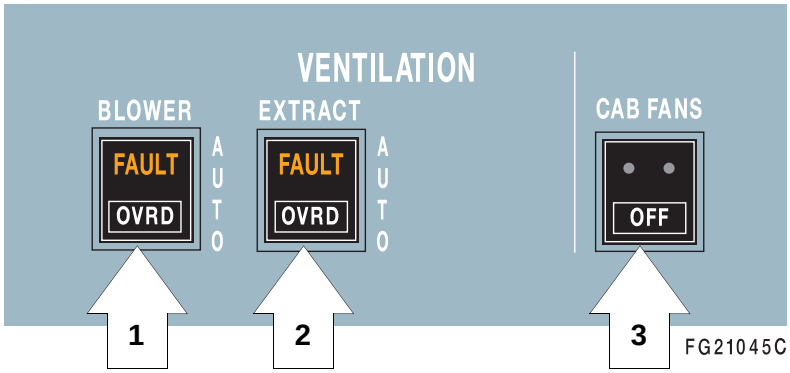
- the outflow valve,
- the emergency ram air inlet,
- the avionics ventilation inlet and extract valves, and
- the pack flow control valves.

Note: The outflow valve will not automatically close if it is being controlled manually by the MAN V/S CTL switch with the MODE SEL pb in MAN.

VENTILATION Panel

Function

The purpose of the panel is to control the non-normal configurations of the avionics cooling system and air recirculation throughout the cabin.



1. BLOWER pb

This pb is used to reconfigure the avionics cooling system when required in response to a system non-normal.

AUTO

When AUTO (lights out) is selected, the avionics ventilation computer configures the system as necessary for current conditions.

OVRD

When OVRD is selected, the ventilation system changes to modified closed configuration which includes air conditioned air added to the ventilation air. The blower fan stops.

FAULT

FAULT illuminates on the BLOWER pb and an ECAM caution is generated when:

- the blower fan pressure is low (if this occurs on the ground with the engines stopped, the external horn sounds),
- an avionics ventilation system duct overheat has been detected (if this occurs on the ground with engines stopped, the external horn sounds),
- the avionics ventilation computer fails, or
- an avionics smoke warning is activated.

VENTILATION Panel (continued)

2. EXTRACT pb

This pb is used to reconfigure the avionics cooling system when required in response to a system abnormal.

AUTO
When AUTO (lights out) is selected, the avionics ventilation computer configures the system as necessary for current conditions.

OVRD
When OVRD is selected, the ventilation system changes to a modified closed configuration which includes air conditioned air added to the ventilation air.

FAULT
FAULT illuminates on the EXTRACT pb and an ECAM caution is generated when:

- extract fan pressure is low (if this occurs on the ground with engines stopped, the external horn sounds),
- the avionics ventilation computer fails, or
- an avionics smoke warning is activated.

1 & 2 BLOWER and EXTRACT pbs

These pbs are also used together to reconfigure the avionics cooling system when required in response to a system abnormal.

AUTO
When AUTO (lights out) is selected on **both** the BLOWER and EXTRACT pbs and the avionics ventilation computer is allowed to configure the system as necessary to meet current conditions.

- If the aircraft is on the ground in warm temperatures, the open configuration is used.
- If the aircraft is on the ground in cold temperatures, the closed configuration is used.
- Once takeoff power is applied and while in flight, the closed configuration is normally used. Extremely high skin temperatures may cause the intermediate configuration to be used.

OVRD
If OVRD is selected on **both** the BLOWER and EXTRACT pbs, the ventilation system changes to a modified configuration which uses air conditioned air, extracts the ventilation air overboard, and does not use the skin heat exchanger. The blower fan stops and the extract fan continues to operate in this configuration.

VENTILATION Panel (continued)

1 & 2 BLOWER and EXTRACT pbs (continued)

10.FAULT
FAULT illuminates on **both** the BLOWER and EXTRACT pbs and an ECAM caution is generated when:

- power supply to the avionics ventilation computer has been interrupted, or
- smoke is detected in the avionics ventilation system.

3. CAB FANS pb

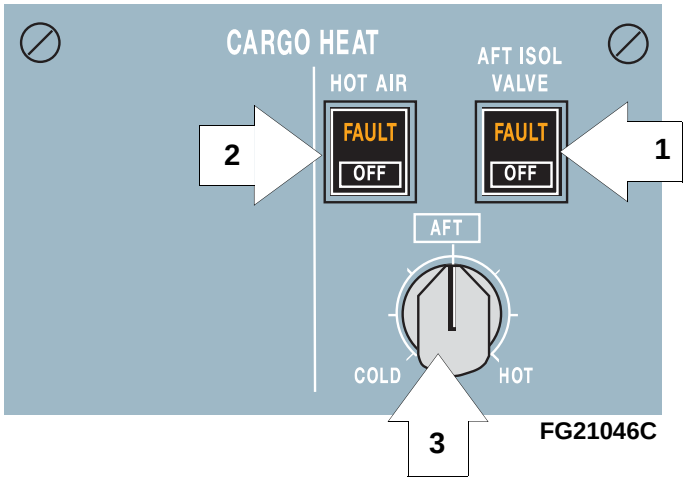
ON
Normal position of the pb (lights out). The two cabin fans run whenever electrical power supplied.

OFF
OFF illuminates and the two cabin fans stop. This position is used in conjunction with smoke related non-normals.

CARGO HEAT Panel

Function

The panel is used to control the ventilation and temperature in the aft cargo compartment.



1. AFT ISOL VALVE pb

This pb controls the isolation valves and the extraction fan.

ON

When selected on, the inlet and the outlet isolation valves open and the extraction fan runs. (If smoke has been detected in the aft cargo compartment the extraction fan stops and the isolation valves close automatically.)

OFF

When the pb is selected off, the inlet and outlet valves close and the extraction fan stops. OFF illuminates white on the pb.

FAULT

FAULT illuminates amber and an ECAM caution is generated when either the inlet or outlet isolation valve position is in disagreement with the selected position.

CARGO HEAT Panel (continued)

2. HOT AIR pb

The pb is used to control the hot air pressure regulator valve.

ON

When selected on (lights out) the hot air valve regulates hot air pressure unless a fault is detected.

OFF

When selected OFF the hot air valve closes. OFF illuminates white on the pb.

FAULT

FAULT illuminates amber and an ECAM caution is generated when a duct overheat is detected. If the pb is then selected off and the duct temperature drops back below a threshold, the FAULT light will extinguish and the system can be reset by selecting the pb on.

3. Temperature Selector

The selector is used to adjust the temperature in the aft cargo compartment.

When a selection to hotter or colder temperature has been made, the change in cargo compartment temperature can be seen on the ECAM COND or CRUISE pages.

Warning/Caution Messages

Air Conditioning Messages

The following table lists the failures and associated messages and warnings that can occur in the air conditioning portion of the air conditioning/pressurization system.

E/WD Failure Condition	Aural Warning	Master Light	System Page	Local Warning
PACK 1 (2) OVHT The pack compressor outlet temp or the pack outlet temp exceeded a predetermined limit.	Single Chime	Master Caution	BLEED	PACK “FAULT” lt
PACK 1 + 2 FAULT One pack is off and the other pack experiences a fault.	Single Chime	Master Caution	BLEED	PACK “FAULT” lt
PACK 1 (2) OFF The pack pb is off with no failure.	Single Chime	Master Caution	BLEED	None
CKPT (FWD CAB or AFT CAB) DUCT OVHT Duct temp exceeded a predetermined limit.	Single Chime	Master Caution	COND	HOT AIR “FAULT” lt
HOT AIR FAULT Hot air valve position disagrees with the pb.	Single Chime	Master Caution	COND	HOT AIR “FAULT” lt
L + R CAB FAN FAULT Both fans are overheated.	Single Chime	Master Caution	COND	None
PACK 1 (2) REGUL FAULT The pack primary channel or both the primary and secondary channels have failed.	None	None	BLEED	None
ZONE REGUL FAULT The primary channel or both the primary and secondary channels have failed.	None	None	COND	None
LAV + GALLEY FAN FAULT	None	None	None	None
TRIM AIR SYS FAULT One trim air valve has experienced a fault or overpressure is sensed downstream of the hot air valve.	None	None	None	None

Chapter 22: Autoflight

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System Description

Location of Autoflight System Components

Introduction

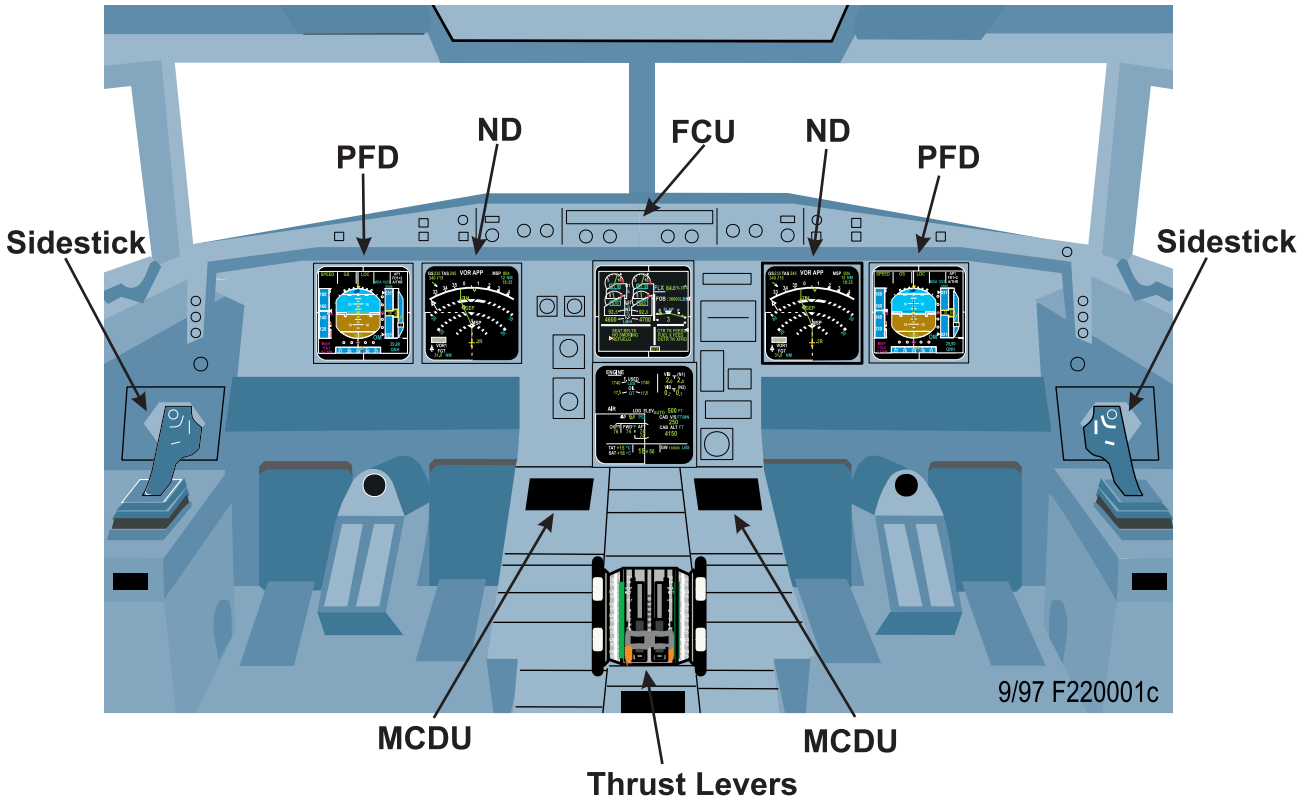
There are a number of components associated with the autoflight system. The pilot interacts with the autoflight system through the:

- Flight Control Unit (FCU),
- the Multifunction Control and Display Units (MCDUs),
- the sidesticks, and
- the thrust levers.

The status of the autoflight system is monitored on the:

- FCU,
- Primary Flight Display (PFD), and
- Navigation Display (ND).

The locations of these components are shown below.



General Description

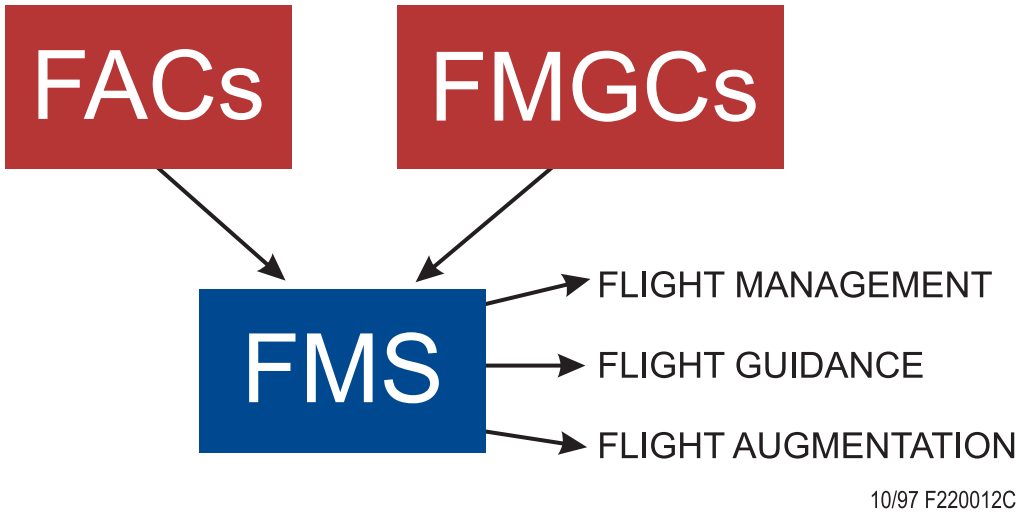
Overview

The autoflight system is part of the Flight Management System (FMS). The two Flight Management Guidance Computers (FMGCs) and the two Flight Augmentation Computers (FACs) completely integrate the FMS, autopilots, and autothrust system.

Operationally, the FMS is split into three parts:

- flight management,
- flight guidance, and
- flight augmentation.

For optimum performance, the autopilot, flight directors, and autothrust are controlled automatically both laterally and vertically throughout all phases of flight. This chapter deals primarily with autoflight and flight guidance.



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Flight Management

The flight management part of the FMS provides navigation, performance optimization, navigation radio autotuning, and information display management. FMGC operational modes and flight management functions are discussed in detail in chapter 34, Navigation.

Flight Guidance

The flight guidance part of the FMS provides:

- autopilot commands (to the flight control computers),
- flight director commands (for PFD display), and
- thrust commands (to the autothrust system).

The pilot can display flight guidance commands on the PFD by engaging the flight directors or autopilot.

Note: The Flight Directors (FDs) are normally on throughout the entire flight.

General Description (continued)

Flight Augmentation

The Flight Augmentation Computers (FACs) provide flight augmentation functions including:

- flight envelope calculations,
- automatic turn coordination, and
- yaw damping.

The flight envelope calculations include maximum and minimum flight speeds, aircraft configuration limits, and maneuvering speeds. These speeds are all displayed on the PFD airspeed indicator and are discussed in detail later. This information is utilized by the autoflight system so that aircraft limits are not exceeded.

The automatic turn coordination and yaw damping functions normally operate at all times, including manual flight.

Additional flight augmentation functions include certain flight envelope protections. The FMGCs, FACs, and flight control computers operate together to prevent the aircraft from exceeding:

- angle of attack (alpha) limits,
- airspeed limits,
- bank angle limits, and
- pitch limits.

(For additional information, refer to chapter 27, Flight Controls: Normal Law Protections.)

System Configuration

When an autopilot is engaged, the associated FMGC generates the flight guidance commands (i.e., when AP 2 is engaged, FMGC 2 generates the flight guidance). If neither autopilot is engaged, FMGC 1 generates the flight guidance (assuming both flight directors are on or off together).

If there is a difference between the computed FMGC navigation positions, changing autopilots cause the aircraft to turn to follow the corresponding navigation guidance.

If an FMGC is inoperative, the associated autopilot, flight director, and autothrust system are inoperative. In this case, the remaining FMGC automatically provides autothrust commands, flight director commands for both PFDs, and autopilot commands for the corresponding autopilot.

General Description (continued)

System Use

The pilot can choose to use all or part of the autoflight systems. For example:

- The pilot can control thrust manually using the thrust levers and manually control the flight path with the sidestick controller. The flight directors may be used to display FMS computed lateral and vertical commands during manual flight.
- The pilot can let the autothrust system control the thrust while manually flying the aircraft, e.g., during a visual approach the autothrust system can be used to maintain approach speed.
- The pilot can manually control thrust while the autopilot flies the aircraft, e.g., following an en route engine failure, the autopilot may be used to control altitude, with thrust manually fixed at Maximum Continuous Thrust (MCT).
- With all autoflight systems engaged, the autothrust system controls thrust and the autopilot flies the aircraft. The pilot can select desired speeds, headings, and altitudes through the Flight Control Unit (FCU). The pilot can allow the flight management system to manage airspeed and lateral/vertical navigation. The pilot can select some functions and allow the flight management system to manage others, e.g., airspeed can be selected to 250 knots while the flight management system navigates along the flight path route.
- Flight guidance may be displayed at any time by engaging the flight directors.

Pilot Interfaces

General

The pilot interacts with the autoflight systems through the:

- FCU,
- MCDU,
- the sidestick controller, and
- the thrust levers.

Status and performance of the autoflight systems can be monitored on the FCU, the Flight Mode Annunciator (FMA), the PFD, and the ND.

Flight Control Unit (FCU)

The FCU is centrally located on the glareshield, providing easy access for both pilots. Four knobs provide control of:

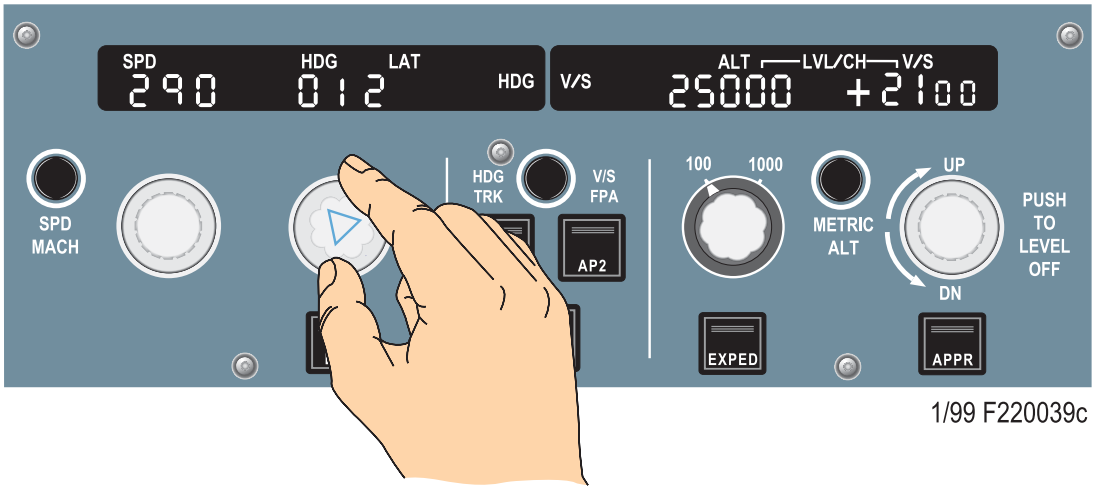
- airspeed,
- heading (or track) or navigation modes,
- climb or descent modes, and
- vertical speed (or flight path angle).

The knobs are spring loaded to the neutral position. If a knob is momentarily pulled, the pilot directly selects (activates) that function. This is called a selected function.

If a knob is momentarily pushed, the FMS computes an optimum value which may vary depending on the flight phase (e.g., climb, cruise, etc). This is called a managed function. The V/S knob is an exception: a momentary push commands an immediate level off.

Selected Functions

Pilot selections of airspeed, heading, open climb/descent, and vertical speed are made by momentarily pulling the appropriate FCU knob. The desired value is selected by turning the knob until the value appears in the FCU window. In the example below, airspeed is selected to 290 KIAS, a heading of 012° is selected, and a 2,100 foot per minute rate of climb to FL250 has been selected.



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Note: Airspeeds cannot be selected with the aircraft on the ground, as this would prevent proper SRS airspeed guidance after takeoff.

Pilot Interfaces (continued)

Flight Control Unit (Continued)

Managed Functions

The pilot transfers control of speed, lateral navigation, or vertical navigation to the FMS by momentarily pushing the appropriate FCU knob. Functions controlled by the FMS result in dashed FCU windows and illuminated managed guidance lights. In the example below, airspeed, lateral navigation, and altitude are all managed with a cruise altitude of FL370 set.

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Note: The FCU altitude window is never dashed.

Note: The V/S (FPA) knob does not have a managed function. Vertical speed (flight path angle) is a selected function only. Pushing the V/S (FPA) knob commands an immediate level off.

Altitude Selections

Altitude selections on the FCU are accomplished by first turning the ALT knob to the desired altitude. The climb or descent is initiated by:

- pulling the ALT knob (resulting in open climb or open descent mode),
- pushing the ALT knob (resulting in managed climb or managed descent mode if NAV mode is engaged),
- depressing the EXPED pb (resulting in an expedited climb or descent), or
- pulling the V/S (FPA) knob and selecting the desired vertical speed.

All FCU actions are discussed in detail in the corresponding flight guidance section of this chapter.

Pilot Interfaces (continued)

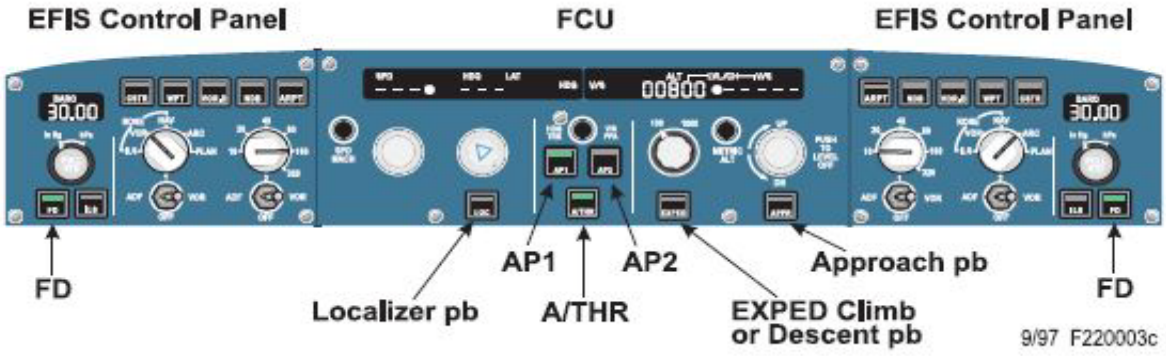
Pushbuttons

Pushbuttons located on the FCU are:

- autopilot (AP) pbs,
- autothrust (A/THR) pb,
- expedite (EXPED) pb,
- localizer (LOC) pb, and
- approach (APPR) pb.

Pushbuttons to select the flight directors are located on the Electronic Flight Instrument System (EFIS) control panels adjacent to the FCU.

A pb is illuminated when the system or mode has been selected. In the example below, both flight directors are engaged, autopilot 1 is engaged, and the autothrust system is armed or active.



Warning

It is imperative that the pilot verify all FCU actions on the PFD, the Flight Mode Annunciator on the PFD, and ND displays.

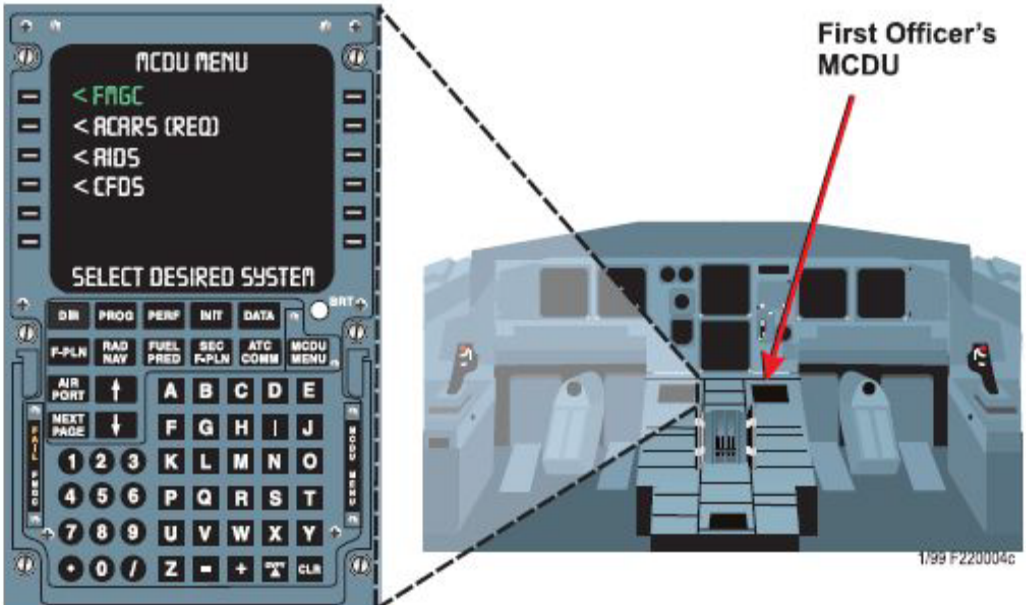
Note: Deselecting the A/THR or an AP with an FCU pb will result in corresponding ECAM failure indications. The A/THR should normally be disconnected with a instinctive pb on either thrust lever. The AP's should normally be disconnected with an autopilot disconnect/takeover pb on a sidestick.

Selection of the A/THR pb prior to engine start may cause false A/THR failure indications during or after engine start.

Pilot Interfaces (continued)

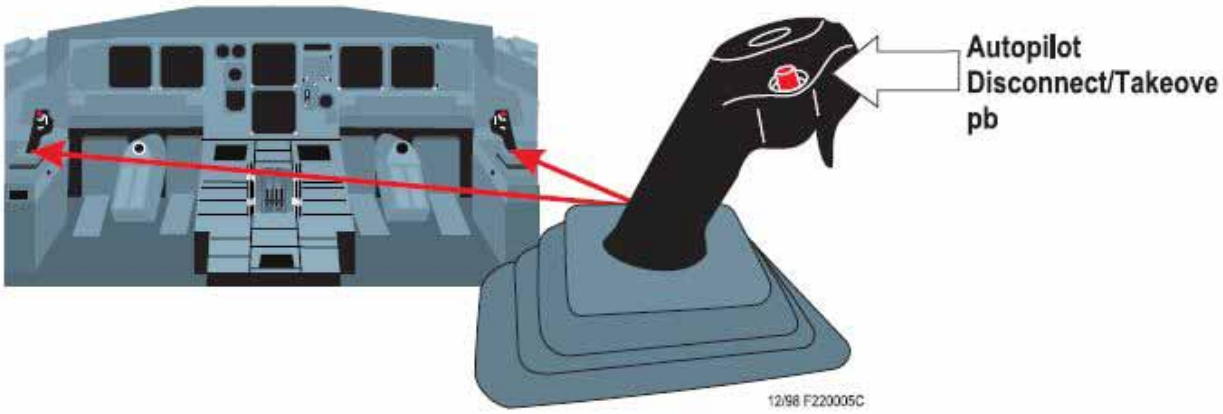
Multifunction Control and Display Unit (MCDU)

The MCDU is the primary interface for entry and display of FMS information. Either of the two MCDUs may be used for actions such as flight plan entry, flight plan and performance monitoring, vertical planning, and flight plan revisions. MCDU flight management operations, operational modes, and displays are discussed in detail in chapter 34, Navigation. The captain's MCDU is shown below.



Sidestick Controller

The sidestick controller is used to manually fly the aircraft. When an autopilot is engaged, both sidestick controllers are automatically centered. An autopilot disconnect/takeover control pb is used to disconnect the autopilot or take over control of the aircraft by electrically disconnecting the other pilots' sidestick (refer to chapter 27, Flight Controls).



Pilot Interfaces (continued)

Thrust Levers

The pilot uses the thrust levers to manually control thrust.

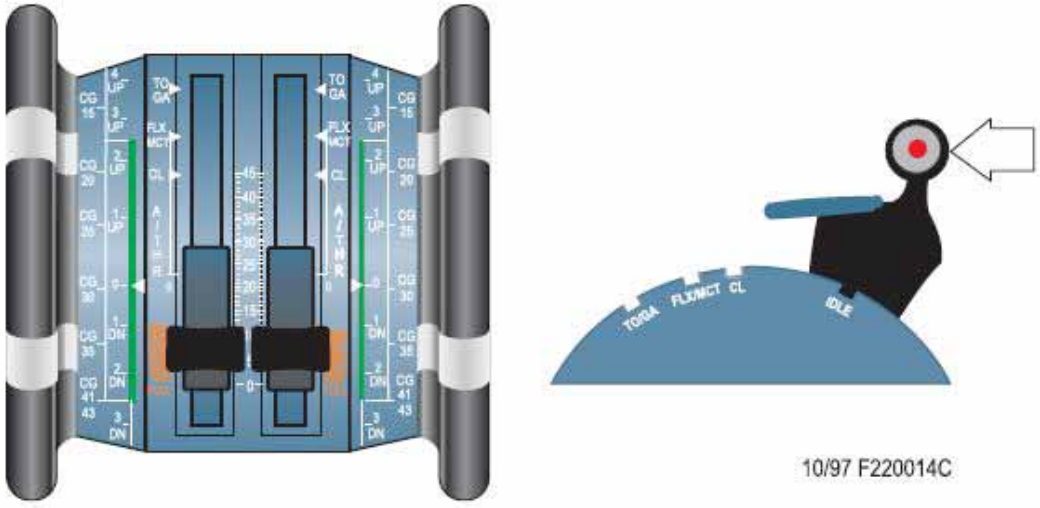
When the autothrust system is armed, the pilot activates autothrust by placing the thrust levers within a specified range. The autothrust system is described in detail later in this chapter.

When advanced to the takeoff/go-around (TOGA) detent, the thrust levers:

- automatically arm the autothrust system during takeoff and go-around (with the flight directors on), and
- automatically engage the takeoff and go-around flight guidance modes (discussed later in this chapter).

Note: Advancing the thrust levers to the FLX/MCT detents during a reduced thrust (flex) takeoff also automatically arms the autothrust system. Flex takeoffs are discussed in detail in chapter 72, Engines.

The outboard side of each thrust lever includes an instinctive disconnect pb. If either pb is depressed, the autothrust system is selected off, and the thrust immediately changes to match the thrust lever position. Depressing a pb a second time cancels the associated master caution and ECAM message.



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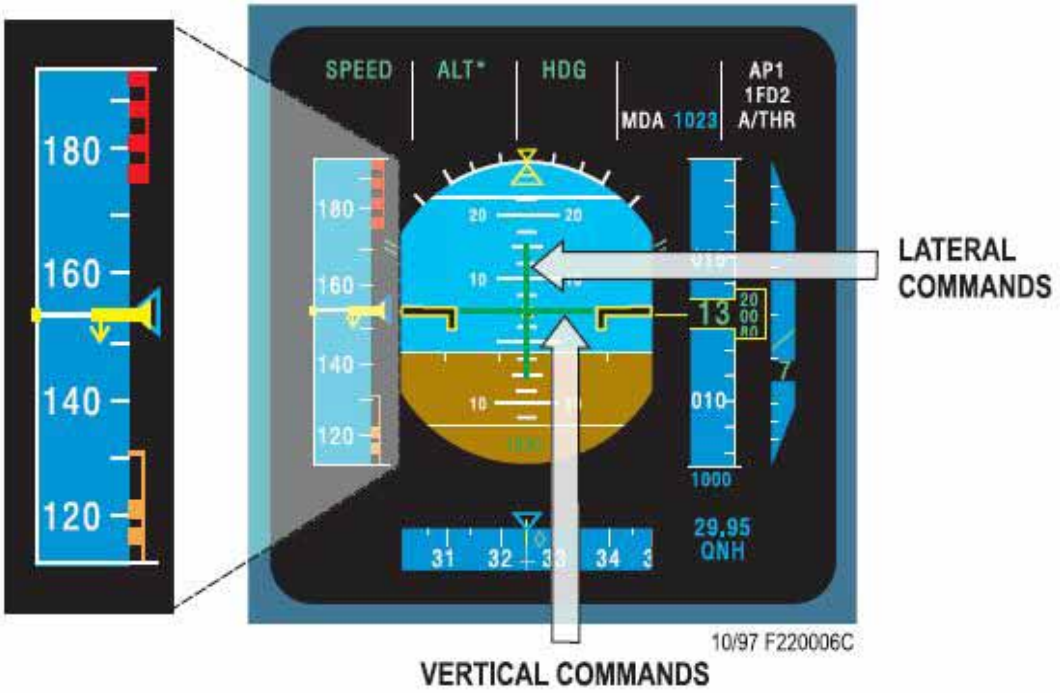
Pilot Interfaces (continued)

Primary Flight Display (PFD)

Flight guidance commands are displayed on the PFD with the flight director bars. Flight envelope information is displayed on the airspeed indicator.The selected FCU altitude, or the active flight plan vertical constraint (refer to CLB and DES modes, described later), is displayed on the altimeter. Flight guidance information presented on the PFD is shown below.



Refer to chapter 31, Flight Instruments, for a complete description of the PFD.

Flight Mode Annunciator (FMA)

The FMA annunciations provide the pilot with an indication of system modes and status. Colors of specific FMA annunciations indicate system or flight guidance status as follows:

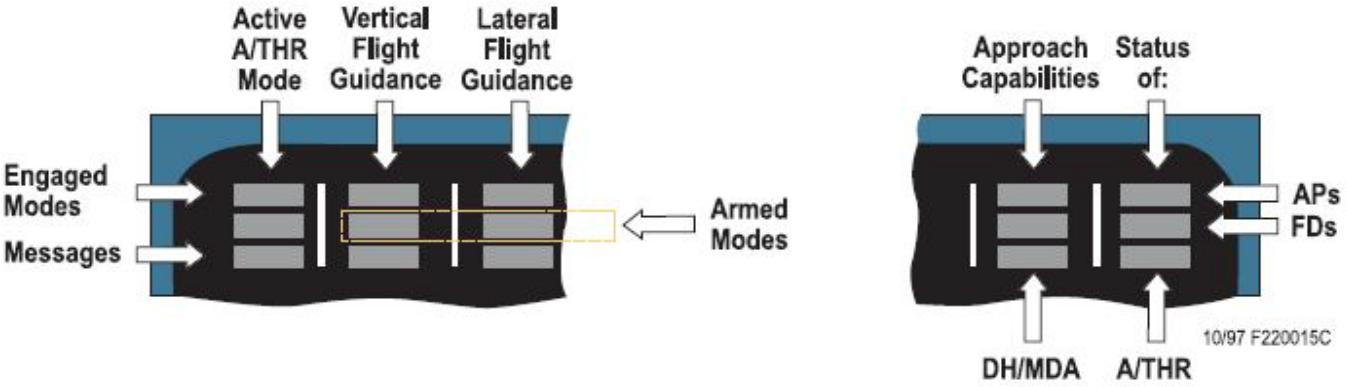
- green annunciations indicate engaged modes,
- blue annunciations indicate armed modes,
- magenta annunciations indicate armed altitude constraints,
- a red annunciation indicates a significant flight control degradation, and
- white annunciations are used to identify aircraft capabilities, engaged autoflight systems, flight director, and active autothrust status.

(Refer to section 22.20, Controls and Indicators, for a complete list of FMA displays.)

Pilot Interfaces (continued)

Flight Mode Annunciator (FMA) (continued)

Both FMAs display identical information (assuming both flight directors are on or both off). The FMA columns are organized as shown below.



Navigation Display (ND)

The NDs provide a display of navigation and flight management related information including:

- flight plan presentation,
- aircraft position and flight path,
- navigation features (airfields, radio aids, waypoints, etc.),
- weather radar displays,
- flight plan vertical and speed constraints, and
- processed data such as level off estimates, wind, etc.

For a complete discussion of flight management displays, refer to chapter 34, Navigation.

Flight Directors

General

Two identical flight directors are installed. Both flight directors are normally on during the entire flight.

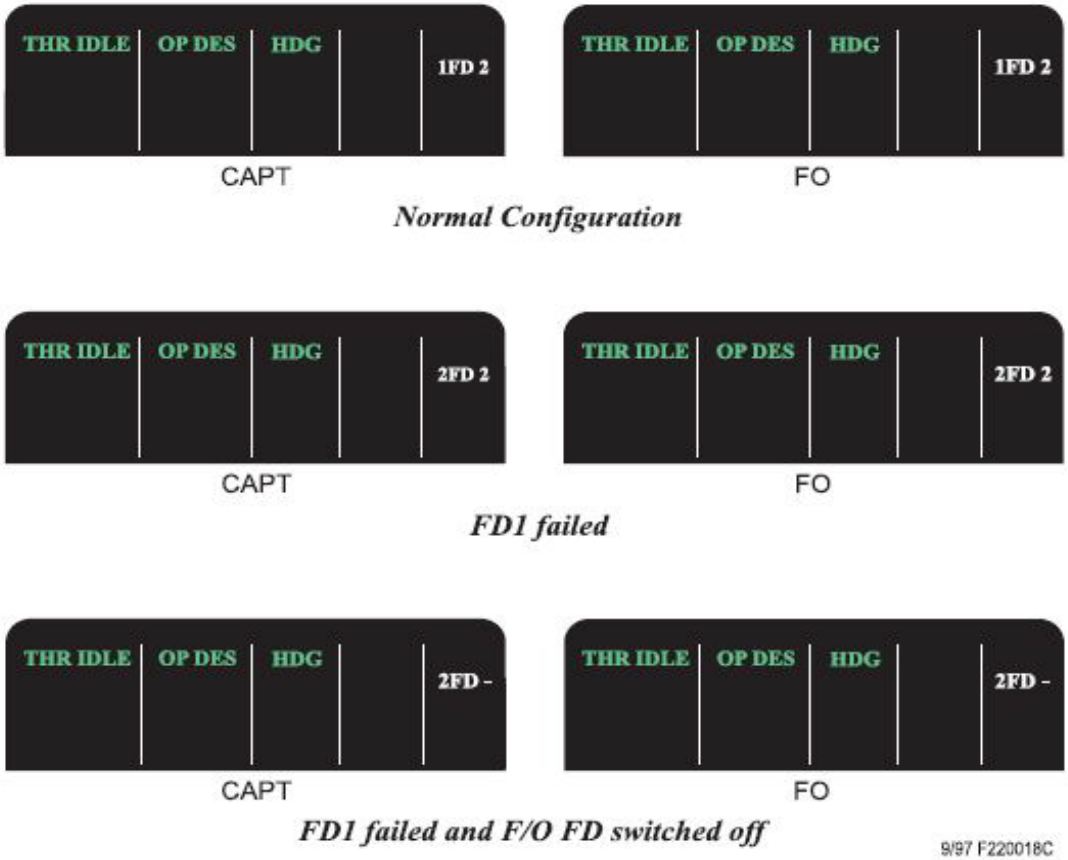
The flight director command bars are automatically removed from the PFDs if aircraft pitch or bank angles exceed preset limits.

At least two IRs must be aligned and operating normally for the flight directors to function.

Normally, FD 1 commands are displayed on the captain's PFD and FD 2 commands are displayed on the first officer's PFD. The normal flight director indication on the FMA is 1FD2, indicating that captain's PFD is receiving commands from FD 1 and the FO's PFD is receiving commands from FD 2. If a flight director fails, the other flight director automatically provides commands to both PFDs. Additional flight director status is displayed in column 5 of both FMAs, as follows:

- a dash is displayed if the FD is off, and
- a "1" is displayed when FD 1 is providing the commands, and a "2" is displayed when FD 2 is providing the commands.

Examples of flight director configurations are shown below:



Flight Directors (continued)

Engagement/ Disengagement

The flight directors are selected on with the associated FD pb on the EFIS control panel.

On the ground, both flight directors are automatically selected when aircraft electrical power is established. In flight, the flight directors automatically engage when the thrust levers are placed to TOGA.

To remove FMS guidance from the aircraft, both flight directors must be selected off and the autopilot disconnected. This results in a blank FMA (except for autothrust indications, if engaged). With both flight directors and autopilots disconnected, the autothrust mode is always SPEED.

Warning

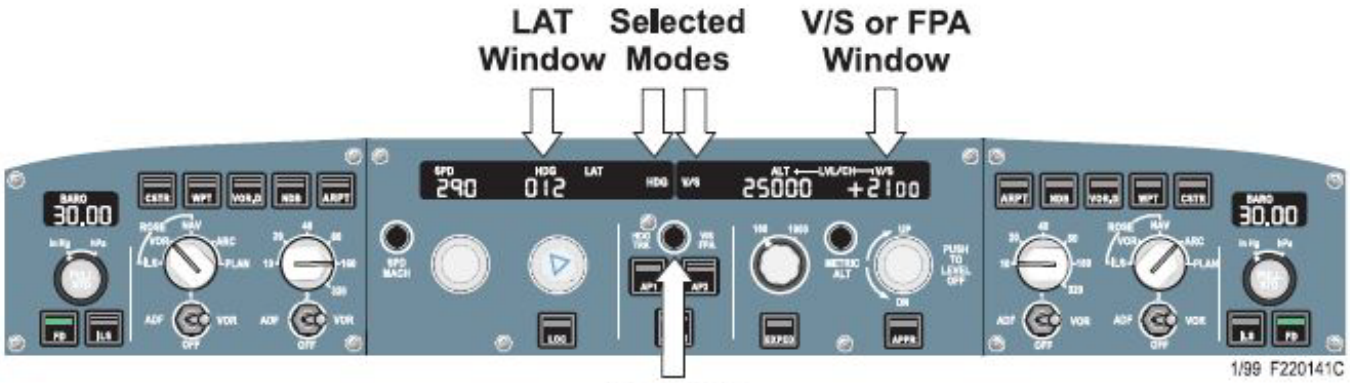
The flight director command bars are displayed on the PFD only when the corresponding flight director is selected on. If only one flight director is on, the command bars are only displayed on that PFD. However, flight guidance modes are engaged whenever at least one flight director or autopilot is on, and must be followed to maintain commanded airspeeds.

For example, the captain is manually flying the aircraft and only the first officer's flight director is on. The command bars are not displayed on the captain's PFD. This could result in the captain ignoring engaged flight guidance commands and result in very fast or very slow airspeeds. Therefore the flight directors must be both on or both off.

Flight Directors (continued)

FD Displays

The pilot can select two types of flight director displays with the heading vertical speed and track flight path angle (HDG V/S & TRK FPA) pb on the FCU.



The mode selected is displayed on the FCU lateral (LAT) window and V/S-FPA windows. The FD symbols displayed on the PFD correspond to either the HDG V/S or TRK FPA selection. These displays are described in detail in chapter 31, Flight Instruments.

The FD modes and corresponding displays are shown below.

HDG V/S

TRK FPA

Flight Directors (continued)

Flight Path Vector (FPV)

The flight path vector (FPV) is displayed on the PFD when the TRK-FPA mode is selected. Selecting the flight directors off removes the command bar and displays only the FPV.

The flight path vector displays the aircraft's horizontal track and vertical flight path angle. Regardless of angle of attack or airspeed, the flight path vector represents the aircraft's instantaneous track and climb angle relative to the horizon.

When the flight path vector is centered vertically on the horizon line, the aircraft is maintaining level flight. Displacement of this symbol above or below the horizon line represents a climb or descent, as appropriate.

The displacement left and right of center represents drift due to wind.

This example displays drift right (wind from the left) and a wings level climb.

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Note: This symbol is automatically displayed in the event of a total FCU failure (dual FCU channel failure).

Flight Director/ Autopilot Relationship

Engaging a flight director or an autopilot engages the flight guidance modes. As long as one flight director or an autopilot is engaged, the flight guidance modes remain engaged. If both flight directors and autopilots are off simultaneously, no flight guidance modes are active.

If the flight directors are engaged and later an autopilot is engaged, the autopilot engages in the same flight guidance modes as the flight directors. If the autopilot is engaged and later the flight directors are engaged, the flight directors engage in the same flight guidance modes as the autopilot. Therefore, the flight directors and autopilot are always initially engaged in the active flight guidance modes.

Flight Directors (continued)

FD Default Modes

When airborne, the flight guidance modes default to HDG-V/S (or TRK-FPA, if selected) when the first flight director or autopilot is engaged. On the ground, the flight guidance modes default to CLB and NAV (refer to Flight Guidance modes described later in this chapter).

For example, if the flight directors are off during a visual approach and later engaged for ILS guidance, the flight guidance modes are HDG-V/S when the flight directors are first engaged. Additional FCU actions are required to couple the flight guidance to the ILS.

Caution: If a takeoff is made with the flight directors off, V_2 defaults to 100 knots.

FD Resets

Occasionally, incorrect flight guidance modes are displayed on the FMA following the initial establishment of aircraft electrical power, after engine start, or after a takeoff abort. To reset the flight directors, both must be turned off together, remain off for a few seconds, and reselected.

The flight director must be selected off prior to resetting an FMGC. (Refer to the QRH, Non-Normal Ops Info (NNOI) chapter, Computer Resets.)

If the flight directors are reset and the autopilot is not engaged, the flight guidance modes default to HDG and V/S when reset to on, regardless of the previous modes (refer to FD Default Modes, above).

Bank Angle Limits

The flight guidance (either flight directors and/or autopilots) limits the maximum commanded bank angle. The commanded bank angle never exceeds 30°, and is normally approximately 25°. It is automatically limited:

- at high true airspeeds,
- after localizer capture at low altitudes, and
- to 15° when operating on one engine in the FMS takeoff and approach phases at speeds less than maneuvering speed.

Note: Maneuvering speed in the clean configuration is green dot. Maneuvering speeds (green dot, S, F, and VAPP) are discussed in detail later in this chapter.

Flight Directors (continued)

Flight Director Failures

Single Failure

The failure of an FMGC results in the failure of the associated flight director (e.g., FMGC1, FD1). The remaining flight director guidance commands are automatically displayed on both PFDs. The flight director bars flash for a short period following this failure. There is no warning message associated with the failure of one flight director.

A single flight director failure is indicated on both FMAs as follows:

- 1FD1 indicates that the first officer's FD (FD 2) has failed and FD 1 has automatically replaced FD 2, or
- 2FD2 indicates that the captain's FD (FD 1) has failed and has been replaced by FD 2.

Dual Failure

If both flight directors fail, a red FD flag is displayed on the PFD, as shown below. If the flight director is selected to TRK/FPA, a "FPV" flag appears on the PFD.

10/97 F220021C

Note: The FD flag is normally displayed during preflight until the inertial reference unit alignments are completed.

Autopilots

General

Two identical autopilots are installed. Each autopilot is associated with the corresponding FMGC (e.g., FMGC 1, AP 1). The autopilot is inoperative if the associated FMGC is inoperative. The failure of one FMGC and the associated autopilot does not affect the opposite autopilot.

Autopilot Requirements

The autopilots do not engage unless all required systems are operating within limits. These systems include:

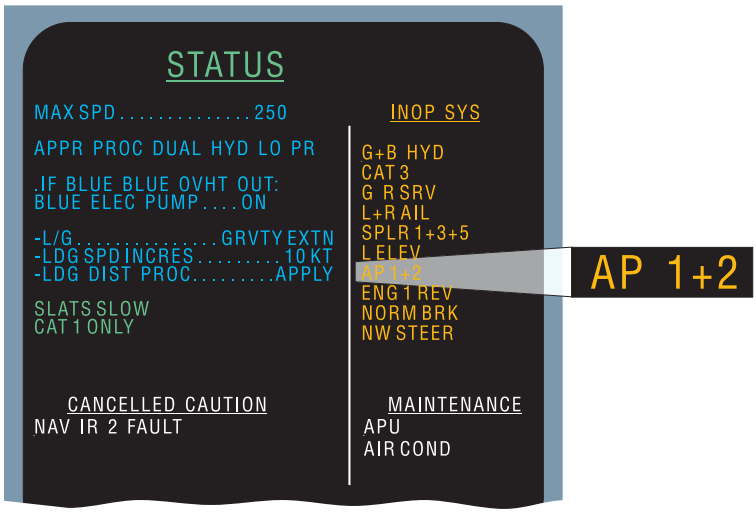
- the associated FMGC,
- certain flight control surfaces,
- at least two ADIRUs, and
- certain flight control computers.

The pilot can attempt to engage an autopilot whenever desired. Due to the independent design, if one autopilot does not engage, the other may engage (depending on the specific failure).

The autopilots may operate with the flight controls in alternate law, depending on the specific failure. The autopilots are normally inoperative with the flight controls in direct law.

Due to the integration of the autopilots and the flight control system, the autopilots require at least one operative radar altimeter to operate with the landing gear extended.

Inoperative autopilots are depicted on the ECAM STATUS page below.



10/97 F220022C

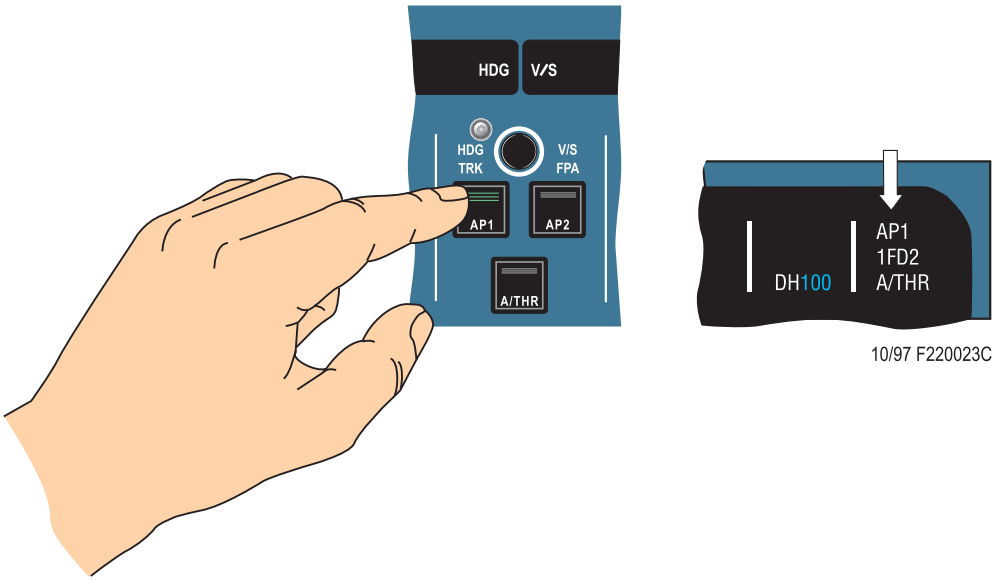
Note: The autopilots are listed as inoperative on the STATUS page during preflight until the inertial reference unit alignments are completed.

Autopilots (continued)

Engagement

The autopilots are engaged by pressing the FCU AP 1 or AP 2 pb. When an autopilot is engaged:

- the sidesticks are automatically centered,
- the illuminated green bars appear in the AP pb, and
- the appropriate FMA annunciation is displayed.



Autopilot Engagement Flight Guidance Modes

If a flight director is on when an autopilot is engaged, the autopilot engages in the active flight guidance modes (e.g., OP CLB and NAV).

If neither flight director is on when an autopilot is engaged, the autopilot engages in the default flight guidance modes (HDG and V/S or TRK-FPA). The engaged flight guidance modes are displayed on the FMA.

Deselecting flight directors after an autopilot has been engaged does not affect the active flight guidance modes.

Disengagement

Normal

The preferred method for disengaging the autopilot is to depress the autopilot disconnect pb on the sidestick controller. This results in a momentary red AP OFF on the right side of the ECAM engine/warning memo display (E/WD) and a momentary aural warning.

Note: An immediate second depression of the instinctive disconnect shortens the aural warning; it will not prevent the aural warning.

Autopilots (continued)

Alternate

The autopilot can be disengaged by:

- depressing the illuminated FCU AP pb, or
- by applying sufficient force to a sidestick controller or a rudder pedal.

Either of these actions will result in a master warning and a red E/WD failure message AUTO FLT AP OFF, along with a continuous repetitive chime (CRC). For example, if the pilot attempts to add rudder following an autolanding, the autopilots will disengage.

Automatic

The autopilot disengages automatically:

- if both thrust levers are set above the FLX/MCT detent with the aircraft on the ground. (Prevents a touch-and-go with the autopilot engaged.)
- if any normal law protection is exceeded or if bank or pitch angles become excessive.
- at airspeeds equal to or less than alpha protection.

Operations

Either autopilot may be engaged a few seconds after takeoff, once the flight controls transition to the flight mode.

Only one autopilot can normally be engaged in flight. If the opposite autopilot is selected, the engaged autopilot disengages automatically, without any failure or warning indications. The second autopilot may be engaged after the APPR pb on the FCU has been armed, during an ILS approach only. The APPR pb is used to couple the flight guidance to the ILS localizer and glide slope. Both autopilots are normally used simultaneously for ILS approaches and autolandings.

Autopilots (continued)

Operations (continued)

With both autopilots engaged, the FMA annunciation “AP 1 + 2” is displayed.

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With both autopilots engaged, autopilot 2 disengages automatically without a caution message:

- when LAND mode is no longer armed or engaged, or
- during a go-around.

Speed Brake/ AP Interaction (A-320 only)

Speed brake deflection with an autopilot engaged is limited to 1/2. With the AP engaged, speed brake deflection corresponds to the handle position from the retract (RET) position to the detent at the 1/2 position. Movement beyond the 1/2 position yields no further extension. However, if the handle is beyond the 1/2 position when the AP is disconnected, the speed brakes rapidly extend to match the handle position.

With the autopilots off, if the speed brakes are extended beyond 1/2 and an autopilot is then engaged, the speed brakes rapidly retract to 1/2.

Engaging or disengaging an autopilot with the speed brakes extended beyond 1/2 is not recommended due to the abrupt retraction or extension of the speed brakes.

Speed Brake/ AP Interaction (A-319 only)

Maximum speed brake extension is not limited with an autopilot engaged. Speed brake extension always corresponds to the handle position. However, the actual spoiler extension at FULL is approximately equal to 1/2 deflection on the A-320.

Autothrust

Purpose

The autothrust (A/THR) system is designed to reduce pilot workload. Autothrust accomplishes this by using either fixed or variable thrust modes of operation.

Fixed Thrust Modes

Fixed thrust modes use constant thrust. Airspeed is controlled with pitch. These modes are used during altitude changes when there is no specified rate of climb or descent.

Variable Thrust Modes

Variable thrust modes of operation change the thrust output to maintain a desired airspeed. Variable thrust modes are primarily used during level flight or when the aircraft is maintaining a specified rate of climb or descent.

System Design

Two autothrust systems are installed. Each autothrust system is associated with a corresponding FMGC. If one FMGC is inoperative, the other autothrust system takes control. If both FMGCs are inoperative, autothrust is also inoperative. There is no direct cockpit indication to tell the pilot which autothrust system is controlling. However:

- If an autopilot is engaged, the corresponding FMGC autothrust system is controlling (e.g., AP 1, A/THR 1).
- If neither autopilot is engaged, then A/THR 1 is controlling.

When autothrust is active, the thrust levers do not move to correspond to the actual thrust level. During normal operations, the thrust levers are placed and remain in the climb (CLB) detent.

Status

The A/THR system is either:

Off

When the A/THR system is off, thrust must be controlled manually. Thrust corresponds to the position of the thrust levers.

Armed

When the A/THR system is armed, the autothrust status will change to active when the pilot moves the thrust levers into the A/THR active range (discussed later).

Autothrust (continued)

Status (continued)

Active

When autothrust is active, it automatically changes from one thrust mode to another (either fixed or variable thrust modes) as necessary to meet thrust requirements.

Monitoring

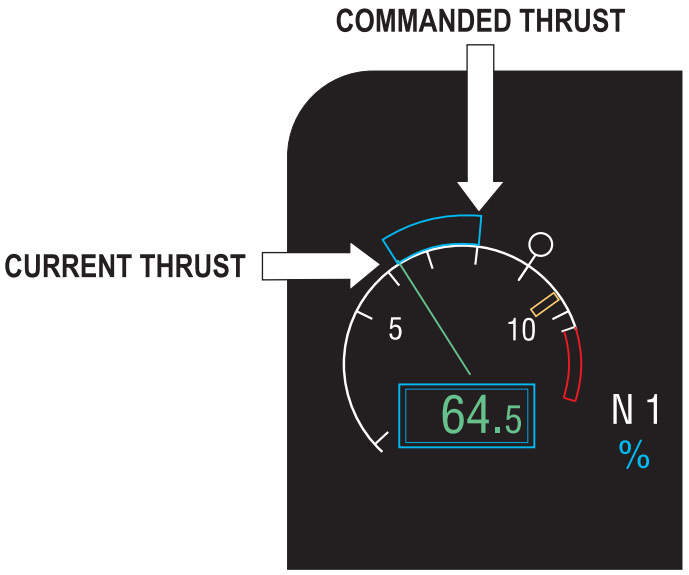
The pilot monitors autothrust operation using the N_1 gauges on the E/WD, the FCU A/THR pb, and the FMA on the PFD.

N_1 Gauges

The autothrust system controls engine output by sending a thrust command to the engine Full Authority Digital Engine Control (FADECs).

Engine thrust commands are based on N_1 and are displayed on the N_1 gauges. The commands are displayed as the far end of a blue arc which extends from the N_1 needle on the gauge.

The blue thrust command arc is only visible during engine acceleration or deceleration to meet a newly computed thrust demand. It is not visible when the new thrust demand is met. An example is shown below.



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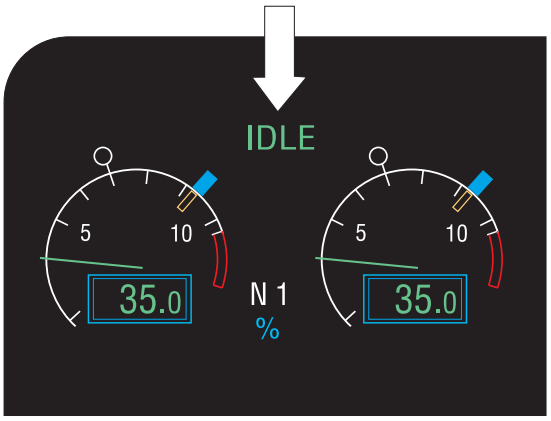
Autothrust (continued)

Monitoring (continued)

N_1 Gauges (continued)

The thrust levers do not automatically move to correspond to the actual thrust level (during normal operations, the thrust levers are in the climb detent). To enhance pilot awareness of low thrust levels, IDLE flashes on the upper ECAM for a short period whenever autothrust commands idle thrust.

Idle remains displayed until an increased thrust level is commanded.



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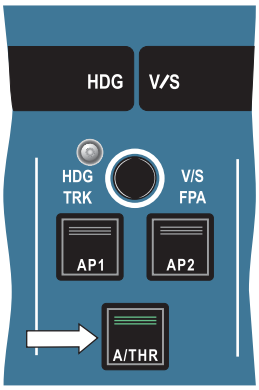
FCU A/THR pb

When this pb is illuminated green A/THR is armed or active.



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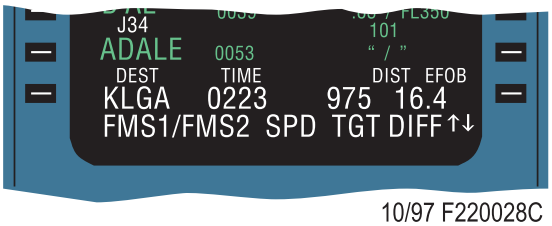
System Comparison

Each autothrust system automatically compares its computed (managed) speed target with the other FMGC. If there is a significant difference between the computed speed targets, a MCDU message is provided.



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Note: If operating in managed speed with this condition, changing autothrust systems (i.e., switching or disconnecting autopilots) will result in an airspeed change.

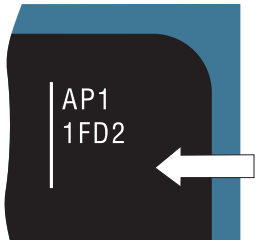
Autothrust (continued)

Monitoring (continued)

FMA

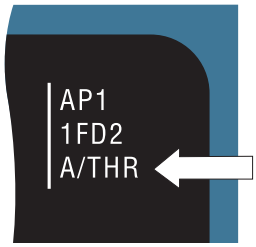
Column 1 displays the current autothrust mode in use and autothrust related messages. All modes and messages are discussed in detail later in this section. The third line of column five displays autothrust status.
Autothrust status is either:

off, with a blank indication



armed, with a blue A/THR displayed or

active, with a white A/THR displayed.



Autothrust Armed

Description

Arming the autothrust prepares it to control the thrust. With autothrust armed and the thrust levers forward of the autothrust active range (discussed later), thrust is controlled manually and corresponds to the position of the thrust levers. Only fixed thrust modes are available when autothrust is armed. These fixed thrust modes are:

- takeoff/go-around (TOGA),
- flex (FLX),
- maximum continuous thrust (MCT), and
- thrust (THR).

When armed, autothrust automatically transitions to active status if the thrust levers are retarded into the active range. If autothrust is active and the thrust levers are advanced forward of the active range, autothrust automatically transitions to armed status. The choice of which mode (armed or active) is in use is dependent upon the position of the thrust levers. All modes are described in detail later in this section.

Autothrust Armed (continued)

Arming

If autothrust is off (with the flight directors on), it is automatically armed during:

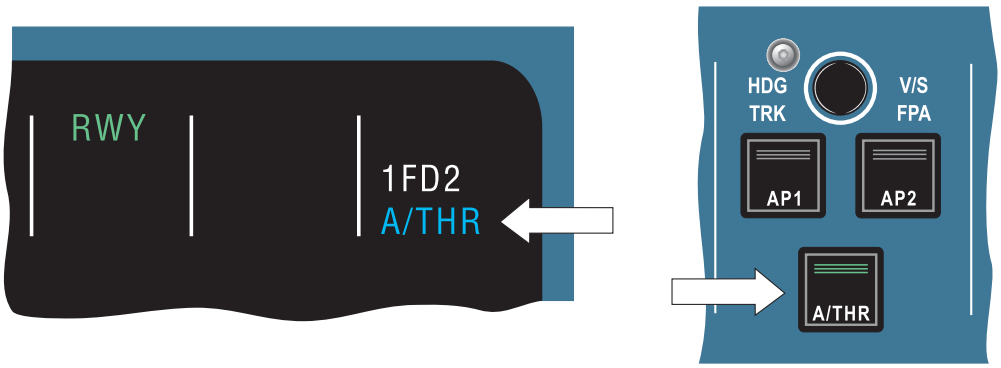
- takeoff when the pilot places the thrust levers in the TOGA or FLX detent.
- flight, with flaps one or greater selected, when the pilot places the thrust levers in the TOGA detent. This also engages the FMS go-around phase.

Autothrust can also be armed manually by pressing the A/THR pb on the FCU when the aircraft is airborne and the thrust levers are forward of the autothrust active range. If the thrust levers are in the active range when the FCU pb is selected, autothrust becomes immediately active.

Armed Indications

The autothrust armed indications located on the FMA and FCU are:

- A/THR is displayed in blue in column five on the FMA, and
- the FCU A/THR pb is illuminated in green.



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Note: The FCU A/THR pb is also illuminated green when autothrust is active. Therefore, the FMA must be referenced to determine if the autothrust status is armed or active.

The armed autothrust mode is displayed in column one of the FMA. Armed modes are displayed in white, surrounded by a white box, with the annunciation MAN displayed, indicating that thrust is being controlled manually. For example, during takeoff (with the flight directors on) autothrust is automatically armed when the thrust levers are advanced to the TOGA or FLX detents. A FLEX takeoff (with an assumed temperature of 50°C) example is shown below.

10/97 F220049C

Autothrust Armed (continued)

Disarming

Autothrust status can be changed from armed to off by:

- pressing one of the red instinctive disconnect pbs on the thrust levers (preferred), or
- pressing the illuminated A/THR pb on the FCU.

Autothrust Active

Description

Active status allows for full use of all of autothrust's automated features. Only in active status can autothrust:

- automatically change from one mode of operation to another to meet thrust requirements, or
- use variable thrust modes. This enables autothrust to maintain selected or managed airspeeds during level flight and during altitude changes when the aircraft is following a specified vertical path. For example, on ILS glide slope, thrust will vary to maintain desired airspeed.

> **Warning**
>
> **With autothrust active, the thrust levers do not automatically move with changes in thrust. The pilot must reference the FMA for active autothrust modes, and the E/WD to determine the actual engine thrust.**

Both fixed thrust and variable thrust modes are available when autothrust is active, fixed thrust modes are:

- MCT,
- CLB (climb),
- IDLE, and
- THR.

Variable thrust modes are SPEED and MACH.

Active Status

Autothrust status changes to active if:

- autothrust is armed and the thrust levers are moved into the autothrust active range, or
- autothrust is off with the thrust levers in the autothrust active range and the FCU A/THR pb is pushed.

Autothrust Active (continued)

Active Range

Two Engines

With both engines operating, the active range extends from just above the idle stop, up to and including the climb (CL) detent. The thrust levers are normally placed in the CL detent at the thrust reduction altitude after takeoff (or earlier if required for a smooth level off) and left there until the landing flare.

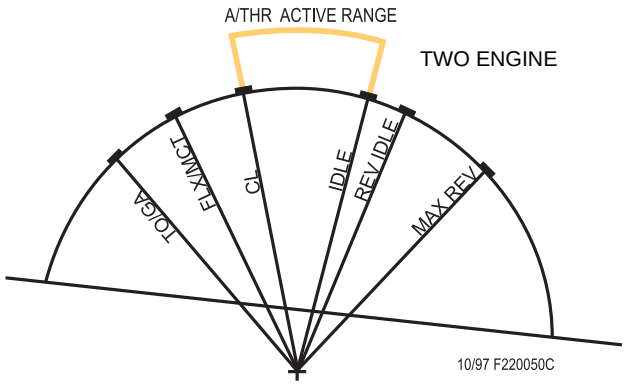
Single Engine

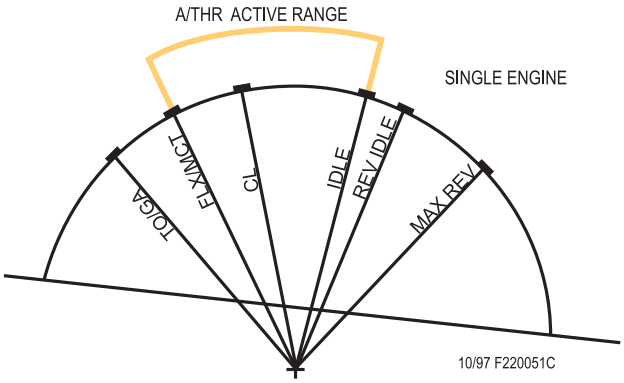
The autothrust active range changes depending on the number of operating engines. The FMS defines an engine failure as:

- an engine master switch in OFF,
- only one thrust lever in idle, or

an engine is operating below a minimum RPM.

With an engine failed, the active range extends from just above the idle stop, up to and including the maximum continuous thrust (MCT) detent. The thrust lever for the operating engine is normally placed in the MCT detent following an engine failure and left there until the landing flare.





Thrust Limiting

When autothrust is active, the position of the thrust levers limits the maximum autothrust authority. Autothrust can never increase thrust above the thrust lever position. In normal operations, the thrust levers are placed in the climb detent and remain there for the entire flight. This allows autothrust to increase thrust as needed up to climb thrust.

If the thrust levers are aft of the CL detent, autothrust cannot increase the thrust above the new limit established by the position of the thrust levers.

Autothrust Active (continued)

Thrust Limiting

If autothrust is active and the thrust levers are limiting the maximum thrust, a master caution is generated along with the following message:

The pilot should move the thrust levers to the CLB detent.

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Active Indications

The pilot can recognize that autothrust is active by referencing the FMA and the FCU. Active indications are:

- A/THR is displayed in white in column five on the FMA, and
- the FCU A/THR pb is illuminated in green.

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The active autothrust mode (green) is displayed in column one of the FMA.

Autothrust Active (continued)

Deactivation

When autothrust is active, the pilot can change autothrust status to armed by moving both thrust levers (two engine operations) or the operating engine thrust lever (single engine operations) forward of the autothrust active range. Engine thrust will increase and corresponds to the thrust lever position.

Normal

Note: If the pilot fails to match the thrust levers to the actual thrust prior to using an instinctive disconnect pb, an engine thrust surge will occur as thrust will immediately increase or decrease to match the thrust lever position.

Autothrust status can be changed to off manually by:

- retarding the thrust levers to the actual thrust using the N_1 gauges, then pressing an instinctive disconnect pb on either thrust lever, or
- retarding both thrust levers to the IDLE detent.

Either of these actions results in the following indications:

- the amber master caution light illuminates for a short period and then extinguishes,
- an amber ECAM A/THR OFF memo is displayed for a few seconds on the right side of the E/WD, and
- a single chime sounds.

Note: The visual and aural indications listed above do not occur when the thrust levers are retarded to the IDLE detent during a landing.

If the pilot wishes to revert from active autothrust to manual thrust operation, the normal method is to first match the thrust levers to the actual thrust by referring to the N_1 gauges. Then an instinctive disconnect pb on one of the thrust levers is pressed.

Alternate

When autothrust is active, the status changes to off if:

- the illuminated FCU A/THR pb is pressed, or
- the autothrust system fails.

These actions result in the following indications:

- the amber master caution light illuminates and a single chime sounds,
- an amber ECAM AUTO FLT A/THR OFF message is displayed on the left side of the E/WD, and
- thrust lock occurs, along with a series of ECAM messages (discussed later).

Autothrust Active (continued)

Permanent Deactivation

If a problem arises with the A/THR, the pilot can permanently deactivate autothrust (including alpha floor) for the remainder of the flight by pressing either instinctive disconnect pb for longer than 15 seconds.

Thrust Lock

If the autothrust is active and is selected off, by deselecting the FCU A/THR pb or because of system failure, with the thrust levers in the CL detent (two engines) or the MCT detent (single engine), the engine thrust does not change until the thrust lever(s) are moved out of the detent. The thrust lock (THR LK) feature prevents changes in engine thrust until the pilot takes additional action. An amber THR LK annunciation flashes in column one of the FMA to alert the pilot to this condition, as shown below.

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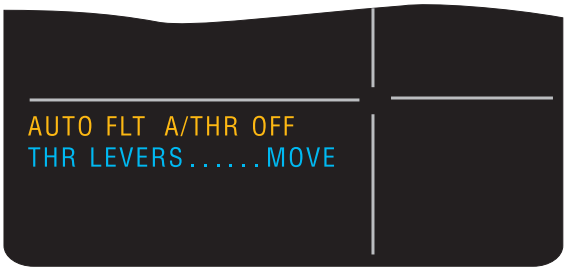
ECAM messages are presented to remind the pilot to move the thrust levers out of the detent and manually control the thrust. In addition, the MASTER CAUT lights illuminate, and a single chime will sound at frequent intervals until the condition is corrected.



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If the thrust levers are not moved within a few seconds, additional ECAM messages are presented:

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Autothrust Active (continued)

Thrust Lock (continued)

When a thrust lock condition exists the pilot can release the thrust lock and remove the THR LK FMA annunciation by:

- reactivating the autothrust (if possible) by pressing the A/THR pb on the FCU. Autothrust status returns to active.
- moving the thrust lever(s) out of the detent. Autothrust will be off and thrust control will be manual. Engine thrust then changes immediately to match the thrust lever position. This is the required action following a failure of A/THR.

Autothrust Modes

Overview

Autothrust uses various modes of operation to provide automated thrust control. These modes are either fixed thrust modes or variable thrust modes. All autothrust mode annunciations are displayed in column 1 of the FMA.

The following sections define the purpose and function of each autothrust mode. The relationships between specific autothrust modes and specific vertical flight guidance modes are discussed in detail later in this chapter.

Note: Manual thrust settings equal to the autothrust fixed thrust modes (for example CLIMB or MCT) are available by placing the thrust levers in the appropriate detent. However, in manual thrust the FCU A/THR pb is not illuminated and autothrust mode annunciations are not displayed on the FMA.

Fixed Thrust Modes

Fixed thrust modes use a constant thrust. Airspeed is controlled with pitch. Fixed thrust modes are used primarily during level changes when there is no specified rate of climb or descent. A MAN annunciation is added to the FMA to indicate that thrust is being manually controlled. When autothrust is armed, i.e. MAN TOGA, MAN MCT, & MAN FLX, a THR annunciation is added to the FMA to indicate fixed thrust modes when autothrust is active, i.e. THR CLB & THR IDLE.

MAN TOGA

FADEC provides maximum fixed thrust. Autothrust status is armed.

MAN TOGA is displayed on the FMA when autothrust is armed and the thrust levers are placed in the TOGA detent.

Autothrust Modes (continued)

Fixed Thrust Modes (continued)

FLX

Flex thrust is used during reduced thrust takeoffs. Autothrust provides a reduced thrust based on an assumed temperature that the pilot enters in the MCDU performance TAKEOFF page. This reduced thrust is equal to the takeoff thrust that would be available at the assumed temperature. The assumed temperature is displayed in blue adjacent to the mode (e.g., FLX 38) on the FMA and E/WD.

- MAN FLX XX is displayed on the FMA when the thrust levers are placed into the FLX/MCT detent when the aircraft is on the ground and the pilot has entered an assumed temperature into the MCDU.

Note: If the thrust levers are placed into the FLX/MCT detent during takeoff and an assumed temperature has not been entered into the MCDU, an ECAM caution (FLEX TEMP NOT SET) is displayed. The takeoff can be continued by selecting TOGA thrust. This will cancel the master caution and change the FMA and E/WD indications to MAN TOGA.

- It is not necessary to delete an entered flex temperature if a TOGA takeoff is desired.

MCT

Autothrust provides maximum continuous thrust for the current ambient conditions.

With both engines operating, MCT is above the autothrust active range and the autothrust status is armed. MAN MCT is displayed on the FMA when the thrust levers are placed in the FLX/MCT detent while airborne.

With one engine operating, MCT is within the autothrust active range. THR MCT is displayed on the FMA when the operating engine is in the MCT detent and the engaged flight guidance mode is using MCT thrust.

Note: Following the loss of an engine during a flex takeoff, the thrust levers must be momentarily moved out of the FLX/MCT detent and then back into the FLX/MCT detent to achieve MCT thrust.

Autothrust Modes (continued)

Fixed Thrust Modes

THR CLB

Autothrust provides climb thrust for the current ambient conditions.

This mode is available only when autothrust status is active.

THR CLB is displayed on the FMA when flight guidance modes are used which require fixed climb thrust. Airspeed is controlled with pitch.

THR IDLE

Autothrust provides fixed idle thrust.

This mode is available only when autothrust status is active. The thrust levers can be anywhere within the autothrust active range.

THR IDLE is displayed on the FMA when flight guidance modes are used which require fixed idle thrust. In these modes, thrust is fixed and airspeed is controlled with pitch.

MAN THR

The term THR is used to describe fixed thrust when that thrust is not equal to TOGA, FLX, MCT, or CLB.This mode is displayed when autothrust status is armed. MAN THR is displayed on the FMA when the thrust levers are not in a detent, and thrust is being controlled manually at a setting between CLB and TOGA.

Autothrust Modes (continued)

Variable Thrust Modes

Autothrust uses variable thrust modes to maintain selected or managed airspeeds during level flight and during altitude changes when the aircraft is following a specified vertical path. For example, when on an ILS glide slope, thrust will vary to maintain the desired airspeed.

Caution: *Autothrust can only operate within its active range. In unusual cases (e.g., a commanded excessive rate of descent) additional pilot action, such as adding drag, may be required to attain/maintain the desired airspeed.*

SPEED

This mode is available only when autothrust status is active. SPEED is displayed on the FMA:

- when the aircraft begins to level off from a climb or descent. Autothrust automatically transitions from a fixed thrust (e.g., THR CLB) to variable thrust, or
- when a flight guidance mode is engaged which commands a specific vertical path. For example, when a vertical speed is commanded, autothrust automatically transitions to the SPEED mode.
- when both flight directors and autopilots are selected off, the autothrust mode is always SPEED.

MACH

This mode is identical to the SPEED mode but is not available at low altitudes. Autothrust automatically transitions from SPEED mode to MACH mode (and vice versa) at a predetermined altitude during climbs and descents. At higher altitudes, either mode can be manually selected.

Autothrust/Flight Director/Autopilot Relationship

Flight Director Commands

If the pilot is hand flying the aircraft with the flight directors engaged and using a fixed autothrust mode (e.g., using CLB thrust in the open climb mode), the flight director pitch command bar indicates the pitch attitude required to maintain the desired speed.

> **Warning**
>
> **If the pilot does not follow the flight director guidance, the airspeed will not be maintained.**

If the pilot flies:

- below the pitch bar, a higher than desired speed will result.
- above the pitch bar, a lower than desired speed will result.

Note: If the speed becomes excessive and the speed approaches a limit (Vmax or VLS), autothrust automatically changes to a variable thrust mode (refer to Automatic Reversions, described later in this chapter).

No Vertical Guidance Used

If no flight directors or autopilots are engaged, the autothrust, if active, automatically uses a variable thrust mode (e.g., SPEED or MACH modes).

Autothrust Optimization

Alpha Floor

To aid in recovering from low speed (high angle of attack) conditions, an autothrust mode called alpha floor is provided. Alpha floor provides TOGA thrust automatically when certain conditions occur.

Engagement

Alpha floor is engaged as a result of:

- excessively high angle of attack (alpha),
- excessively high nose up attitudes combined with specific sidestick inputs, or
- indirectly, as a result of windshear.

When alpha floor engages TOGA thrust is automatically applied. Alpha floor engages regardless of thrust lever position as long as autothrust is operational. Alpha floor can be engaged even with autothrust off and the thrust levers positioned in the IDLE detent.

Operating Envelope

Alpha floor is normally available from immediately after takeoff throughout the flight down to 100 feet radio altitude with the aircraft in the landing configuration. The minimum altitude prevents alpha floor from engaging during the landing flare.

Alpha floor is not available:

- if the flight controls are not operating in normal law (refer to chapter 27, Flight Controls),
- if autothrust is inoperative, or
- if autothrust has been permanently deactivated by pressing an instinctive disconnect pb on a thrust lever for more than 15 seconds.

TOGA Lock

Alpha floor is automatically disengaged when the conditions that triggered alpha floor (excessive angle of attack) are no longer present. When alpha floor is automatically disengaged, the thrust remains locked at TOGA power. This condition is called TOGA lock (TOGA LK). Autothrust will remain in TOGA lock until:

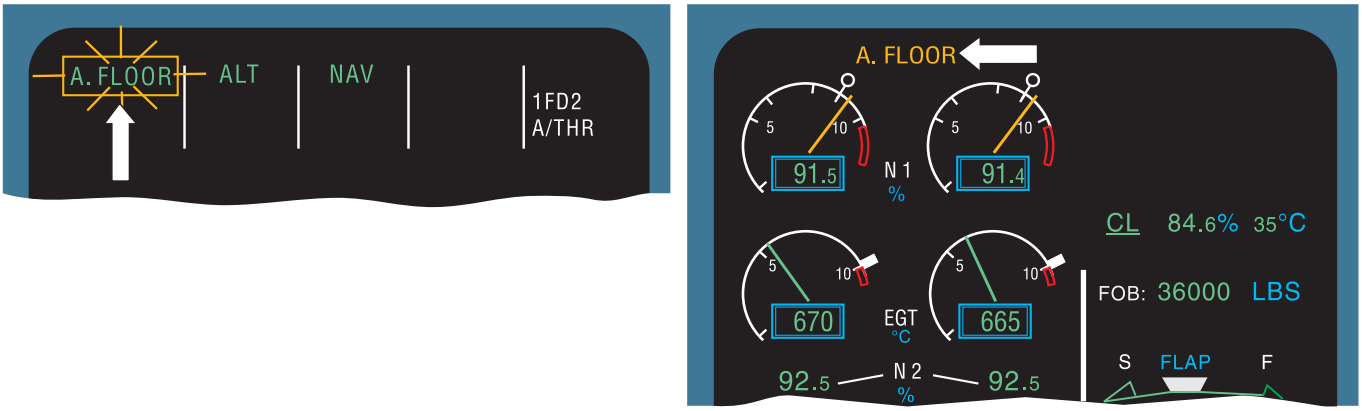
- the pilot deactivates autothrust (thrust control then reverts to manual), or
- the aircraft is flown back into the alpha floor triggering condition (alpha floor is then automatically re-engaged).

Autothrust Optimization (continued)

Alpha Floor (continued)

Alpha Floor Indications

Alpha floor engagement is indicated on the FMA and the E/WD as shown below.



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When alpha floor conditions no longer exist, TOGA LK replaces the A FLOOR indication on the FMA.

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Autothrust Optimization (continued)

Alpha Floor (continued)

Both alpha floor and TOGA lock provide fixed TOGA thrust. As indicated in column five of the FMA, autothrust status is active when these modes are engaged. This is because automatic mode changes from A FLOOR to TOGA LK or from TOGA LK back to A FLOOR will occur as the aircraft enters or exits the alpha floor condition.

The following notes apply to alpha floor and clarify situations which could occur if the recommended deactivation sequence is not used.

Note: To regain the ability to use other autothrust modes, the pilot must first deactivate and then reactivate autothrust. When alpha floor is engaged it can be disengaged and autothrust deactivated at any time by:

- pressing the illuminated FCU A/THR pb,
- pressing an instinctive disconnect pb on a thrust lever, or
- retarding both thrust levers to the IDLE detent, or cycling the thrust levers back to the IDLE detent.

Warning:

These actions will cancel alpha floor and deactivate autothrust even if the triggering condition (excessive angle of attack) is still present.

Cancelling Alpha Floor with an instinctive disconnect pb on a thrust lever will always cancel Alpha Floor and TOGA Lock, and will result in thrust immediately matching the thrust lever position. However, the recommended sequence discussed on the previous page should be used to prevent large thrust variations.

Caution: *If the pilot presses and holds either instinctive disconnect PB for more than 15 seconds, the Auto Thrust system is disconnected for the remainder of the flight. All Auto Thrust functions including Alpha Floor are lost. The Auto Thrust system will reactivate at the next FMGC power-up.*

Flight Guidance

Types of Flight Guidance

Flight guidance is provided for speed control, lateral navigation, and vertical navigation. There are two types of flight guidance: selected and managed.

Selected Guidance

Selected guidance is a result of a pilot selection on the FCU. For example, the pilot selects a climb airspeed of 290 KIAS. Selected guidance always has priority over managed guidance.

Managed Guidance

Optimized airspeeds are computed by the FMS for each FMS flight phase. These optimized airspeeds are called managed. The FMS also provides managed lateral and vertical flight plan guidance after MCDU flight plan entry.

Both types of guidance may be simultaneously selected for different functions. For example, lateral guidance along the flight path may be managed at the same time that airspeed is selected to maintain an ATC clearance.

Selected Guidance

Selected guidance is enabled by momentarily pulling on the associated FCU knob and setting the desired value. The selected values are displayed in the FCU windows along with FMA, PFD, and ND annunciations. Selected airspeed, lateral navigation (HDG), and vertical speed FCU indications are shown below.

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Flight Guidance (continued)

Managed Guidance

Managed guidance follows commands generated by the FMS. For managed guidance to be available, at least one flight director or autopilot must be engaged.

Note: With all fight directors and autopilots off, managed speed guidance is also available in the FMS approach phase.

The pilot can recognize managed guidance for a particular function by dashed FCU windows and associated illuminated managed guidance lights. Managed guidance is activated by momentarily pushing on the associated FCU knob. Other indications include FMA, PFD, and ND annunciations to be described later. Managed speed, navigation, and vertical navigation FCU indications are shown below.

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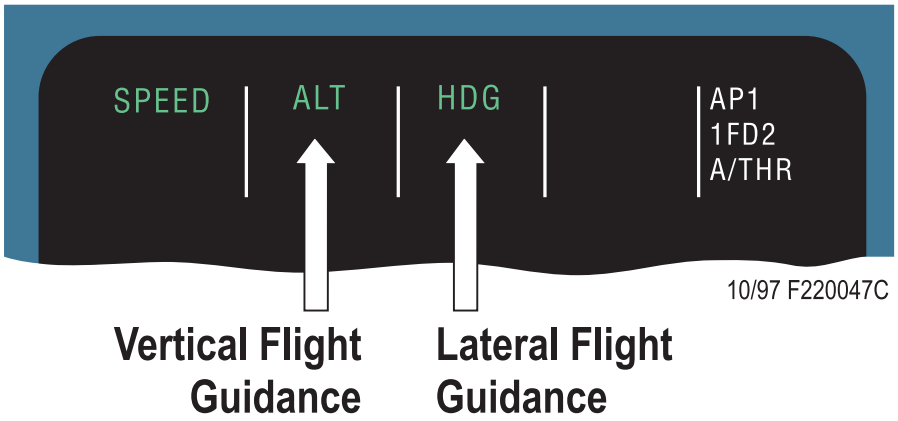
Note: The FCU altitude window is never dashed.

Flight Guidance Indications

Engaged flight guidance modes are displayed on the FMA when:

- an autopilot is engaged, or
- the corresponding flight director is on.



When the flight director is selected on, the flight guidance commands are also displayed on the PFD.

Note: The flight directors are normally on throughout the entire flight.

When an autopilot is engaged, the aircraft will automatically follow the flight guidance commands. If the flight directors are also on, the pilot can monitor the autopilot's performance in following those commands.

Speed Guidance

Overview

Flight guidance is provided for speed control with the PFD flight director pitch command bar and the PFD airspeed indicator using FAC computed symbols.

Warning:

When the pilot is hand flying the aircraft with the flight directors on, the pitch command bar must be followed or the speed may vary excessively.

Selected and managed speed guidance are available regardless of autothrust status. When autothrust is active, it automatically adjusts thrust modes and thrust output as necessary to follow the speed guidance. In manual thrust, the pilot must vary the thrust as necessary to follow the speed guidance.

Selected Speeds

The pilot selects a desired speed by momentarily pulling the SPD/MACH knob on the FCU. When the SPD/MACH knob is pulled, the current speed is selected. The desired SPD/MACH is selected by rotating the SPD/MACH knob to the desired value. Selected speeds may be selected shortly after takeoff. The pilot can verify that speed is selected by:

- a blue triangle on the PFD airspeed indicator,
- the presence of a digital display in the FCU SPD/MACH window, and
- the absence of an illuminated managed guidance light next to the FCU digital display.

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Speed Guidance (continued)

Managed Speeds

The pilot activates managed speed by momentarily pushing the SPD/MACH knob on the FCU.

Note: At least one flight director or autopilot must be engaged for managed speeds to function. Exception: In the FMS approach phase, managed speeds are available with the flight directors and autopilots off.

The pilot can verify that speed is managed by:

- a magenta triangle on the PFD airspeed indication,
- the absence of a digital speed display in the FCU SPD/MACH window, and
- the presence of an illuminated managed guidance light next to the digital display.

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The FMS managed speed can be verified by checking the MCDU performance (PERF) page for the present or future flight phases.

Note: Managed speeds require that a ZFW be entered in the FMS. If autothrust operates normally using selected speeds, but managed speeds do not function, confirm that a ZFW is entered on the MCDU FUEL PRED page.

Speed Guidance (continued)

Flight Envelope Characteristic Speeds

The autoflight system includes a number of features which optimize the aircraft speed and improve flight safety.

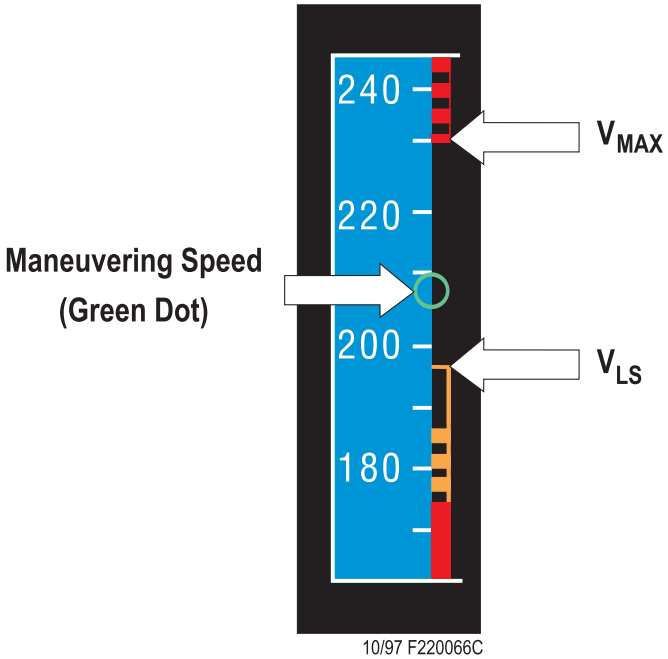
The FACs constantly compute and display the aircraft flight envelope on the PFD airspeed indicator. These speeds are:

- A minimum safe airspeed (V_{LS}).
- A maximum airspeed for the current flap/slat or landing gear configuration (V_{MAX}).
- A maximum operating airspeed (V_{MO}) equal to 350 KIAS/0.82 Mach.

Note: V_{MAX} is equal to V_{MO} in the clean configuration.

- A maximum airspeed for the next flap configuration (V_{FE} NEXT or flaps next).
- an airspeed trend arrow.
- A maneuvering speed. This speed is called:
  - green dot in the clean configuration,
  - S with flaps 1 selected,
  - F with flaps 2 or 3 selected, and
  - An optimum approach speed (V_{APP}).
- A minimum ground speed (GS_{mini}) during approach.

The PFD airspeed indicator includes displays of V_{MAX}, V_{LS}, maneuvering speed, and V_{APP}, when appropriate. Alpha floor and GS_{mini} are not depicted.



If autothrust is active, it adjusts thrust as necessary to keep the airspeed within the flight envelope between V_{MAX} and V_{LS}. If autothrust is not active, the pilot must manually adjust thrust to remain within the depicted flight envelope.

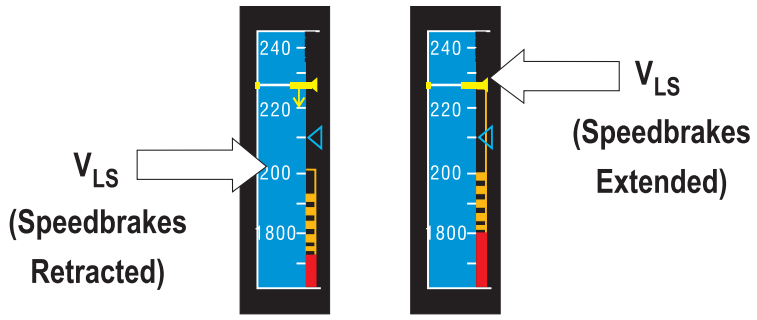
Speed Guidance (continued)

V_{LS}

The lowest safe speed for the current configuration is called V_{LS}. If the pilot inadvertently selects a speed below V_{LS}, the autothrust limits the aircraft speed to V_{LS} (assuming flight director guidance is being followed). If autothrust is off, the flight guidance will honor V_{LS} whenever it is using a pitch mode (for example, with thrust manually fixed at idle, the flight guidance will not descend in OP DES mode slower than V_{LS}). V_{LS} is calculated for the current aircraft configuration (slat/flap setting and speedbrakes). Selecting a different flap setting, for example, results in a change in the displayed V_{LS}.

Note: When speedbrakes are deployed, V_{LS} increases significantly, particularly in the clean configuration. V_{LS} increases proportionately to the amount of speedbrake extension.

If V_{LS} increases to a speed above the current aircraft speed, the autothrust system commands an increase in thrust to increase speed to V_{LS}. This would occur, for example, during a high energy approach (slam dunk) when the speedbrakes are deployed and maneuvering at green dot speed. An example of the effect of speedbrakes on V_{LS} is shown below.



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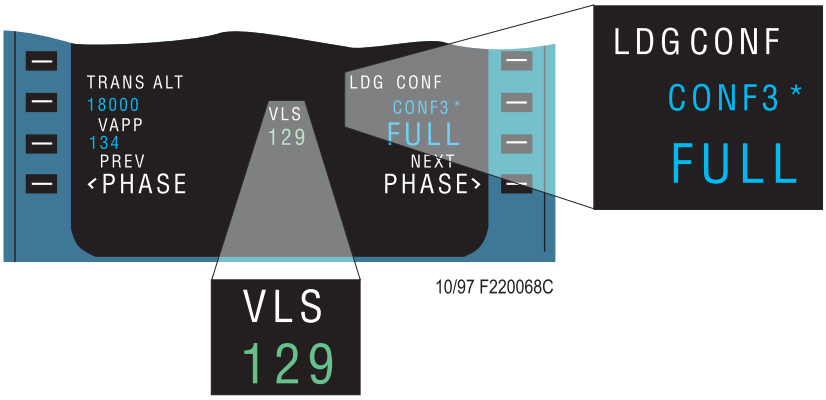
Note: The V_{LS} displayed on the PFD airspeed indication is calculated for the current aircraft configuration. Do not confuse this PFD indication with the V_{LS} displayed on the MCDU performance APPR page. The MCDU V_{LS} is calculated at the MCDU selected landing configuration (normally flaps FULL) and does not vary with changes in the current aircraft configuration. The MCDU performance APPR page V_{LS} is shown below. MCDU V_{LS} is comparable to V_{REF}.



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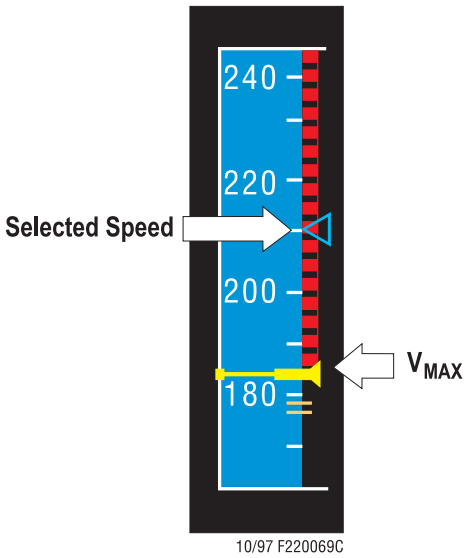
Speed Guidance (continued)

V_{MAX}

Maximum airspeed is limited to a high speed limit (V_{MAX}) calculated for the current configuration (landing gear and slats/flaps).

The autothrust system (if active) will automatically reduce thrust to limit the aircraft speed to V_{MAX}, regardless of the pilot selected speed (assuming flight director guidance is being followed). as shown below**.**

At flaps 3, V_{MAX} is 185 KIAS. If a pilot inadvertently selects a speed of 210 KIAS, the autothrust system only allows the aircraft to accelerate to 185 KIAS. The pilot can recognize that this has occurred as the selected speed triangle is above V_{MAX}.



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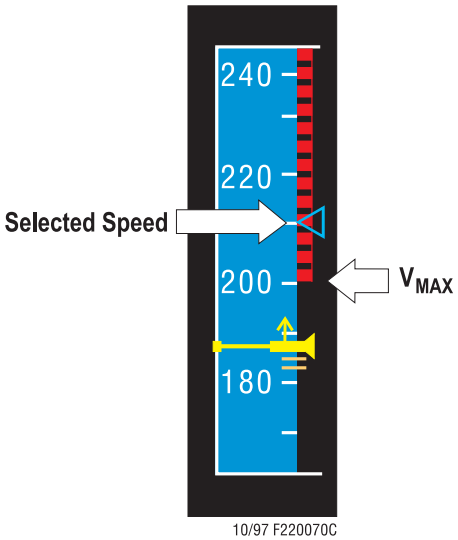
If the configuration is changed, V_{MAX} changes accordingly.



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In the clean configuration, V_{MAX} and the maximum operating speed (V_{MO}) are the same.

Note: It is possible to overspeed the aircraft (landing gear and slats/flaps) if limits are ignored when configuring. Autothrust will reduce thrust, allowing the aircraft to slow below the configuration limit when this occurs.

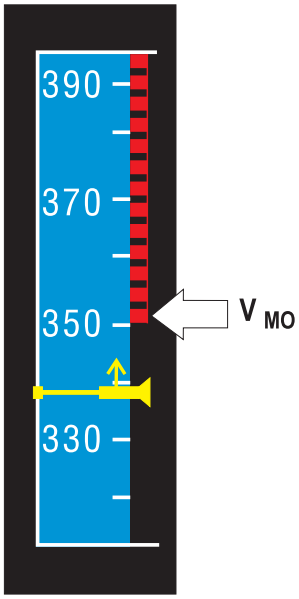
This feature (V_{MAX}) is designed to prevent aircraft damage and must not be used for controlling aircraft speed.

Speed Guidance (continued)

V_{MO}

The maximum operating speed is displayed at 350 KIAS/0.82 Mach.

If the pilot inadvertently selects a speed above V_{MO}, autothrust (if active) reduces thrust to remain below this speed. If the pilot is manually flying the aircraft and attempts to exceed this speed by lowering the nose, the flight control system high speed protection automatically limits the maximum speed by raising the nose.



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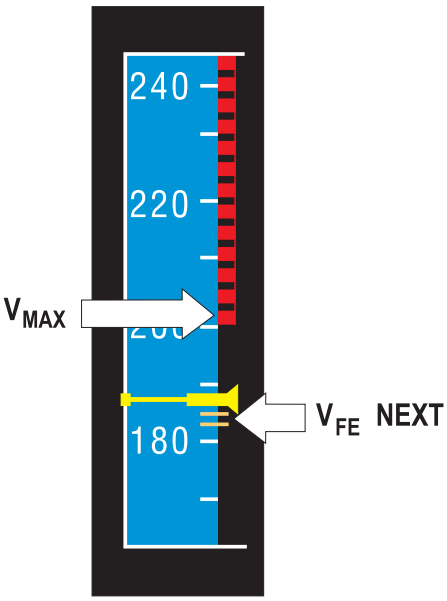
V_{FE} NEXT

The maximum extension speed for the next flap configuration (V_{FE} NEXT) is displayed on the airspeed indicator at lower altitudes.

V_{MAX} displays the maximum airspeed for the current configuration.

V_{FE} NEXT indicates where V_{MAX} will be if the flaps/slats are extended to the next configuration. The next flap configuration must not be selected until the airspeed is at or less than the displayed V_{FE} NEXT. In the example shown, V_{MAX} is 200 KIAS, indicating that flaps 2 has been selected.

V_{FE} NEXT is displayed at 185, indicating the maximum extension airspeed for flaps 3.



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Speed Trend Arrow

The FACs compute a speed trend arrow that is displayed on the airspeed indicator It identifies the airspeed the aircraft will attain in 10 seconds, and is described in detail in chapter 31, Flight Instruments.

Speed Guidance (continued)

Maneuvering Speed

The FAC computes the airspeed for the best lift to drag ratio. This speed is called maneuvering speed, and is depicted on the PFD airspeed indicator. Maneuvering speed provides the:

- best angle of climb speed,
- best glide speed, and
- minimum maneuvering speed.

These speeds are displayed on the PFD airspeed indicator, as described in chapter 31, Flight Instruments. These speeds are dependent on the selected aircraft configuration, as follows:

- in the clean configuration, it is depicted as a green dot.
- with the flaps 1, the speed is depicted as a green S.
- with the flaps 2 or 3, it is depicted as a green F.
- with the flaps FULL, it is depicted as a magenta triangle (V_{APP}).

Warning

These computed speeds correspond to the position of the flap/slat handle, not the actual position of the flaps/slats. Use managed speeds with caution when operating with abnormal flap/slat configurations.

Green Dot

Green dot is the computed maneuvering speed in the clean configuration. At this speed, the aircraft climbs at the maximum angle and descends at the maximum glide ratio with the available thrust. If the aircraft is in a normal climb (for example at 290 KIAS) and the pilot wishes to momentarily increase the climb rate to meet an ATC request, the airspeed can be reduced towards green dot. During a descent, any speed reduction towards green dot reduces the rate of descent. Following an engine failure:

- climbing at green dot in the clean configuration significantly improves climb performance.
- descending at green dot (at MCT thrust) maximizes the glide ratio during an en route driftdown.
- cruising at green dot (at MCT thrust) maximizes the single engine ceiling. This altitude is significantly above the long range single engine cruise altitude displayed on the MCDU PROG page (refer to chapter 34, Navigation: MCDU Operations).

The aircraft climbs at green dot speed when the expedite climb mode (EXP CLB) is selected.

Speed Guidance (continued)

Managed Speed During Approach

In the FMS approach (APPR) phase, managed speed is the maneuvering speed. The managed speed is dependent on the aircraft configuration, as previously described. If in managed speed with autothrust active, airspeed will automatically change as the aircraft configuration is changed. The FMS computed speeds can be verified by referencing the MCDU performance APPR page.

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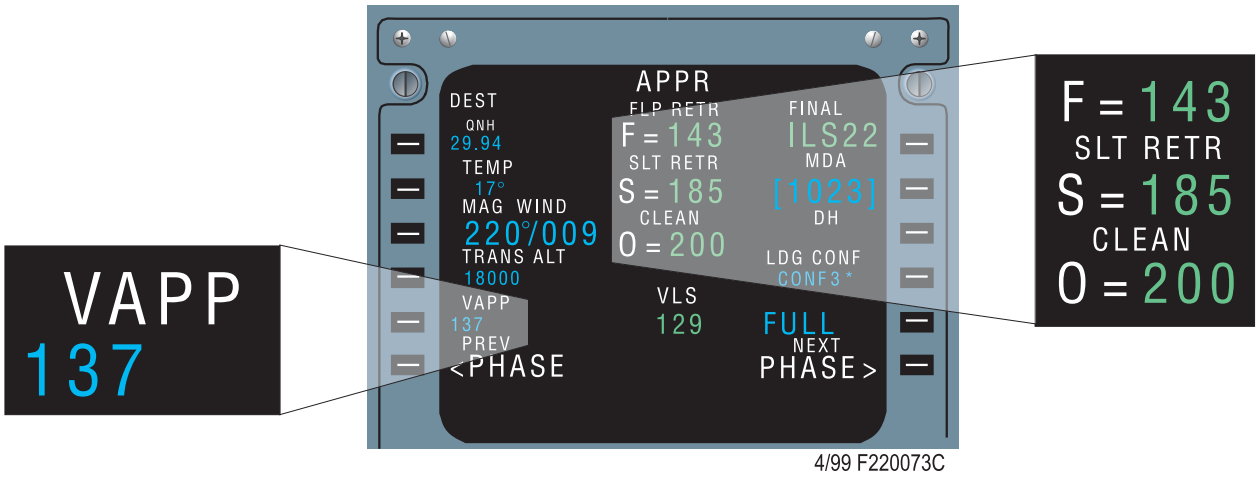

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V_{APP}

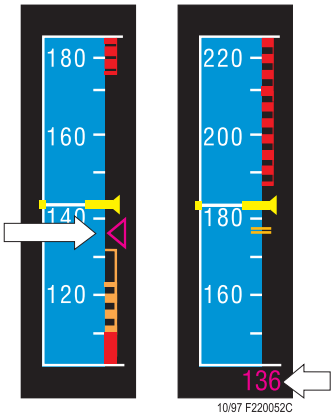
V_{APP} is the computed approach speed when the flaps are selected to the landing configuration.

For V_{APP} to be displayed on the PFD airspeed indicator, the following conditions must be met:

- the FMS APPR phase must be active, and
- managed speed must be activated.

Note: The magenta target speed displayed on the PFD airspeed indicator may include airspeed additives due to GS_{mini}. In windy conditions, this may cause the V_{APP} displayed on the PFD to be significantly higher than that displayed on the MCDU PERF APPR page.

V_{APP} is depicted as a magenta triangle on the IAS scale, or digitally at the bottom of the IAS scale when the computed speed is off scale.



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Speed Guidance (continued)

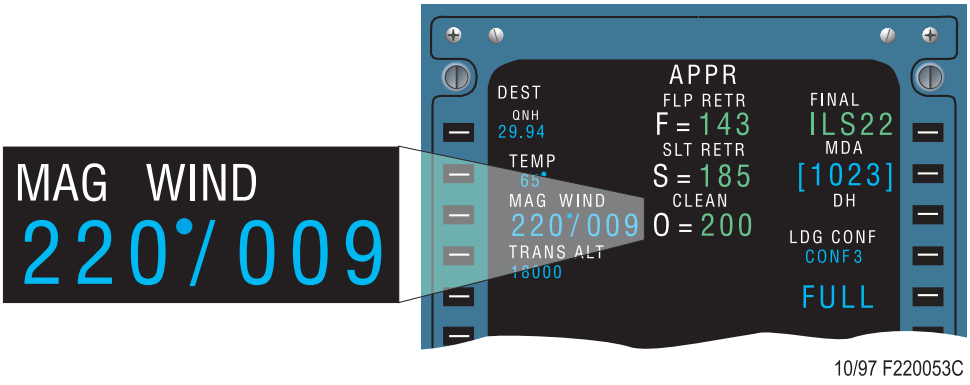
V_{APP} (continued)

V_{APP} is computed as follows:

1. The pilot selects the desired landing configuration on the MCDU performance APPR page. The default configuration is Flaps FULL.

Note: V_{LS} increases 5 knots if LDG CONF 3 is selected.

2. V_{APP} is equal to V_{LS} + 5 knots + 1/3 of the runway headwinds component as entered via the MCDU (up to 15 knots increase). To be calculated correctly, the pilot must enter (on the appropriate MCDU pages) the landing runway and current steady state airfield winds.



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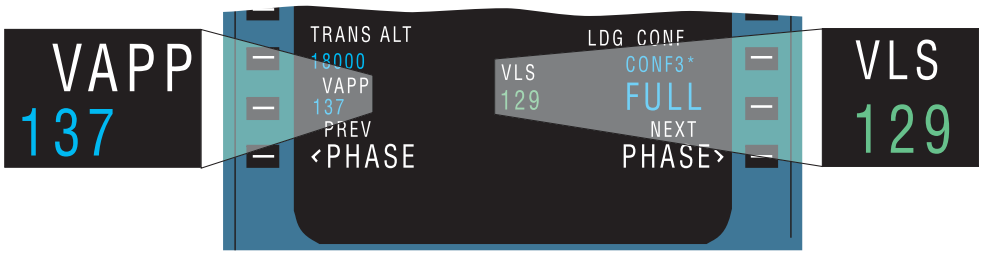
3. V_{APP} and V_{LS} are displayed on the MCDU PERF APPR page. In the example below, V_{APP} = V_{LS} + 5 knots + 1/3 runway headwind (9 knots) = 137 knots.



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Note: The pilot can modify V_{APP} on the MCDU performance APPR page, if required. For example, the QRH requires an increased V_{APP} when landing with flaps locked. By modifying V_{APP} on the MCDU, a modified managed speed is available.

Note: If a V_{APP} has been manually modified (e.g., per a QRH Non-Normal Checklist), and the pilot has changed the landing runway on the MCDU F-PLN page, V_{APP} will revert to the FMS calculated value. Pilot must again manually modify V_{APP}.

319 Differences

The calculation of V_{APP} on the A-319 is slightly different. V_{APP} = V_{LS} + 1/3 runway headwind. A minimum runway headwind of 15 knots is assumed. A maximum headwind of 45 knots is allowed. This limits the headwind additive from 5 - 15 knots.

For example, with a 9 knot headwind and a V_{LS} of 129 knots, V_{APP} = 129 + 1/3 (9) = 134 (when a 5 knot minimum headwind additive is used).

Speed Guidance (continued)

Ground Speed Mini

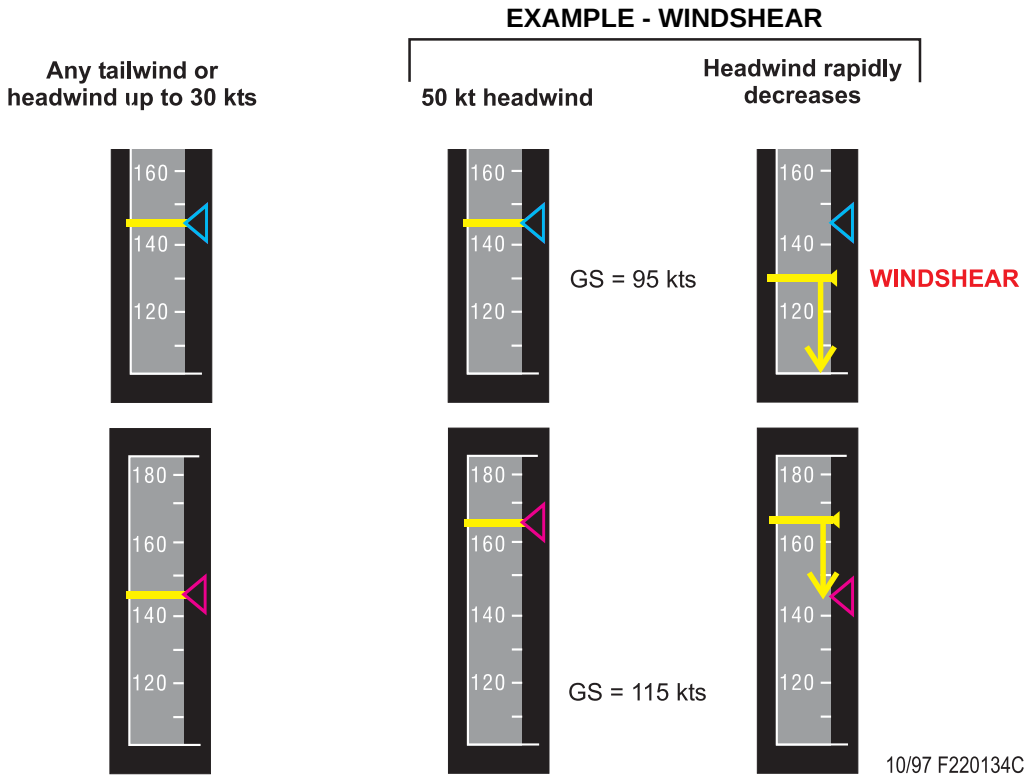
The FMS computes a minimum ground speed during approach, which provides the aircraft with significant windshear protection. For GS_{mini} to be correctly calculated, the pilot must enter airfield data for V_{APP} into the MCDU. GS_{mini} only functions in the FMS APPR phase and in managed speed.

The FMS calculates a minimum ground speed which accounts for V_{APP} and pilot entered steady state runway headwinds. $GS_{mini} = V_{APP}$ -runway headwind. A minimum headwind of 10 knots is always assumed. The FMS causes the target airspeed to increase above V_{APP} if a headwind greater than those entered is encountered. This ensures that the ground speed does not fall below GS_{mini}. GS_{mini} never decreases the target speed below V_{APP}. In the example below, V_{APP} is 135 knots and a 30 knot headwind has been entered into the MCDU. V_{APP} = 135 + 1/3 (30) = 145 knots. $GS_{mini}=V_{APP}$ -30 = 115 knots.

A

S

M
GS mini ACTIVE



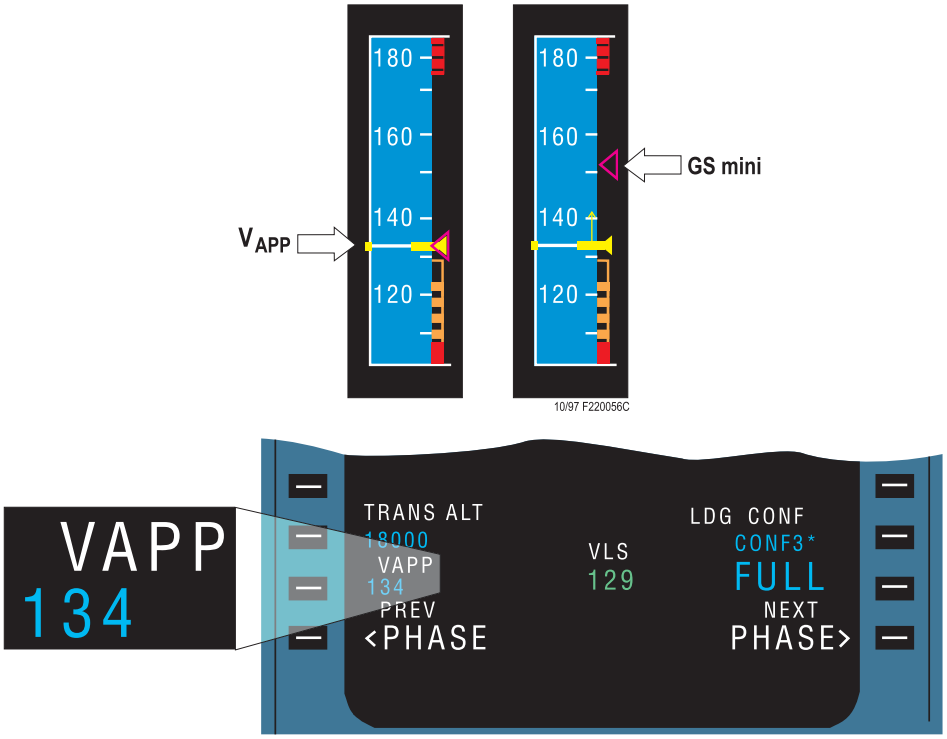
Pilot selection of the runway, and pilot entry of steady state airfield winds, have an important effect on the calculation of GS_{mini}. A reduction in the pilot entered wind value increases GS_{mini} by a proportional amount. In the example above, a reduction of the airfield wind to 15 knots (versus 30) would have increased GS_{mini} to 125 knots. Note that the reduction of the headwind also reduces V_{APP} because the wind additive is also reduced. The result: V_{APP} =135 +1/3 (15 knots)=140 knots.
$GS_{mini}=V_{APP}$ -15 = 125 knots.

Note: Pilots are not required to memorize V_{APP} or GS_{mini} formulas.

Speed Guidance (continued)

Ground Speed Mini (continued)

No direct indication of GS_{mini} is provided. GS_{mini} is depicted on the PFD as a V_{APP} airspeed target. The pilot can recognize that GS_{mini} is active by noting that the magenta V_{APP} triangle has moved to an airspeed higher than the computed V_{APP}, as displayed on the MCDU performance APPR page. An example is shown below.



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A/THR During Landing Flare

Autothrust is normally used during landings to maintain approach speed (V_{APP}) or a selected speed. The operation of autothrust during the landing flare is different between normal and autolandings.

Normal Landing

During a normal landing, autothrust is in the SPEED mode, with thrust varying to maintain V_{APP} (or a selected speed). At approximately 20 feet AGL an aural “RETARD” callout is heard, instructing the pilot to retard the thrust levers to idle. If the thrust levers are incorrectly left in the CL detent, autothrust increases thrust to maintain V_{APP} during the flare, preventing a normal touchdown. The pilot must retard the thrust levers during the flare.

Automatic Landing

During an autolanding, autothrust is in the SPEED mode, with thrust varying to maintain V_{APP} (or a selected speed). Autothrust will automatically retard the thrust to idle during the flare and IDLE will be annunciated on the FMA. At 10 feet AGL, an aural “RETARD” callout is heard, instructing the pilot to retard the thrust levers to idle. Autothrust will automatically reduce the thrust to idle, even if the thrust levers are incorrectly left in the CL detent. However, the pilot should retard the thrust levers when the “RETARD” callout is heard. Reverse thrust, if desired, must be manually selected.

Lateral Guidance Modes

General

The lateral modes provide en route flight guidance along a lateral path selected through the FCU (HDG or TRK), or managed guidance following a previously constructed flight plan. During an approach, lateral flight guidance can be automatically provided by coupling:

- the lateral flight guidance to a localizer signal, or
- the FMS along a flight plan non-precision approach (discussed later in this chapter).

Note: It is not possible to couple the lateral flight guidance to a VOR, NDB, or localizer backcourse signal.

Selected Lateral Modes

Heading (or Track) Mode

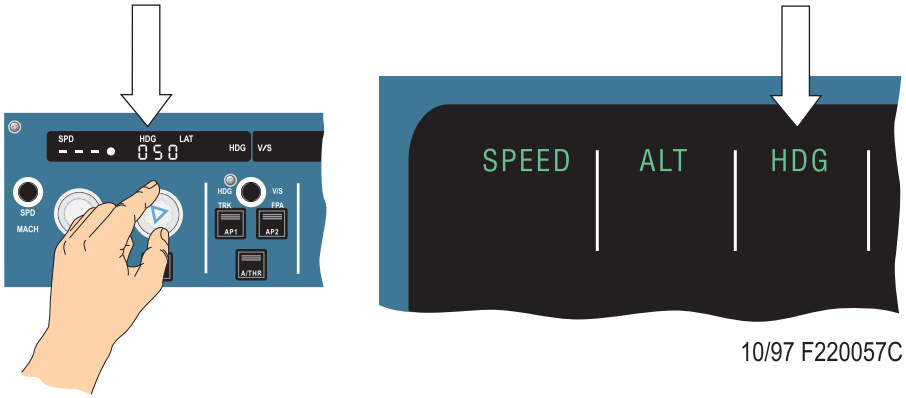
This mode provides lateral guidance along a heading (HDG) or track (TRK). It is selected by pulling on the FCU HDG (or TRK) knob.

The HDG/TRK reference is selected by using the HDG-V/S/TRK-FPA pb on the FCU. If HDG is switched to TRK, or vice versa, the value displayed in the FCU window switches from heading to track.

The pilot can recognize that the HDG (or TRK) mode is active by:

- noting the digital display in the FCU LAT window,
- the absence of a managed guidance light, and
- the HDG (or TRK) mode displayed on the FMA.

An example is shown below.



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Note: The HDG (or TRK) mode cannot be engaged at low altitudes when LAND mode is active (e.g., LAND annunciated on the FMA). This prevents the pilot from inadvertently disengaging the flight guidance from tracking the localizer during an ILS approach.

Selected Lateral Modes (continued)

HDG/TRK Selection

The sequence of FCU HDG (TRK) knob actions determines the direction of turn, as follows:

- If the HDG (TRK) knob is turned to the desired heading, and the knob is then pulled, the guidance commands the shortest direction to turn.
- If the knob is pulled and the knob is then turned to the desired heading, the guidance commands the corresponding direction of turn.
- If the knob is pulled and not turned, the current aircraft HDG (TRK) is selected.
- If a HDG (TRK) is selected but the knob is not pulled, the selected value is removed after several seconds (with a few exceptions discussed in HDG/TRK PRESET).

HDG/TRK Preset

A heading can be preset by turning the HDG/TRK knob without pulling. The selected value remains in the FCU window for approximately one minute. It will remain in the window continually in the following cases:

- prior to takeoff, and
- whenever LOC*, LOC, APP NAV, LAND, or GO-AROUND modes are engaged. This allows a missed approach heading to be preset during the final portion of an instrument approach.

After a heading has been preset, the guidance continues to follow the current mode. When the heading knob is pulled, the guidance will be to the preset heading, e.g., if a heading was preset before takeoff, the lateral guidance maintains the runway track until the HDG/TRK knob is pulled.

HDG/TRK Automatic Engagement

The HDG (or TRK) mode is the default lateral mode. If no other modes are selected or possible, this mode is automatically engaged. The HDG (or TRK) mode is automatically engaged in the following cases:

- when the first flight director or autopilot is engaged,
- if the flight directors are reset with both autopilots off (refer to Flight Director Resets, this chapter),
- if LOC mode is deselected or lost (this would be the case if the ILS localizer transmitter failed), or
- the aircraft enters a flight plan discontinuity in managed NAV, e.g., when the aircraft reached the end of the flight plan.

HDG/TRK Disengagement

HDG (or TRK) mode is disengaged by engagement of any other lateral mode.

Note: The TRK display automatically switches to HDG when a go around is initiated and managed NAV is armed.

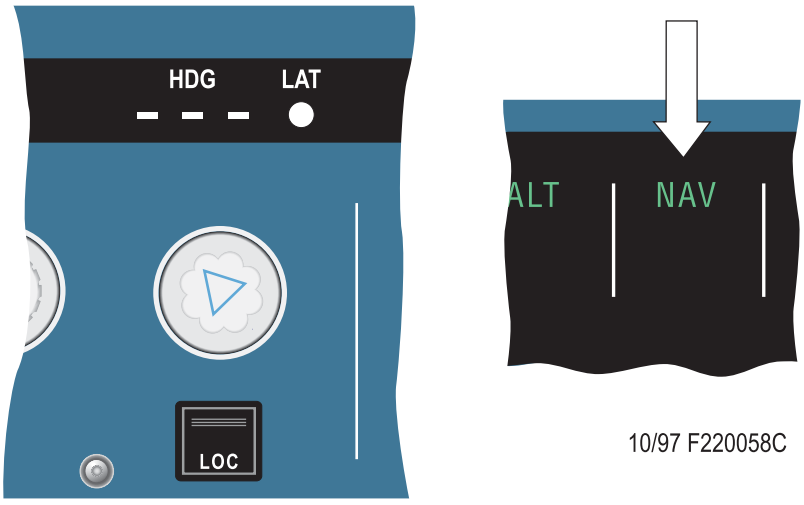
Managed Lateral Mode

Managed NAV Mode

Managed navigation (NAV) mode provides lateral guidance along the flight plan stored in the FMS. It is manually activated by pushing on the FCU HDG (or TRK) knob. NAV mode does not engage unless the aircraft is on or near the flight plan course. The pilot can recognize that the NAV mode is engaged by:

- the absence of a digital display in the FCU HDG (TRK) window,
- the presence of a managed guidance light, and
- green NAV displayed on line 1, column 3 of the FMA.

An example is shown below.



Note: NAV mode cannot be engaged at low altitudes when LAND mode is engaged. This prevents the pilot from inadvertently disengaging the flight guidance from tracking the localizer during an approach.

NAV Mode Automatic Arming and Engagement

Managed NAV mode is automatically armed when the aircraft is on the ground following engine start and is either automatically armed or stays active during a go-around. (See also GO-AROUND mode, this chapter.)

Managed NAV mode is automatically engaged following an MCDU “DIRECT TO” function.

Managed NAV mode is armed when thrust lever(s) are placed in the TOGA detent on a go-around from an ILS or LOC approach unless a heading has been pre-selected.

NAV Disengagement

Managed NAV disengagement occurs:

- when any other lateral mode is engaged, e.g., a HDG is selected, or localizer is captured; or
- if the aircraft enters a flight plan discontinuity (refer to chapter 34, Navigation: MCDU Operations) or the end of the flight plan.

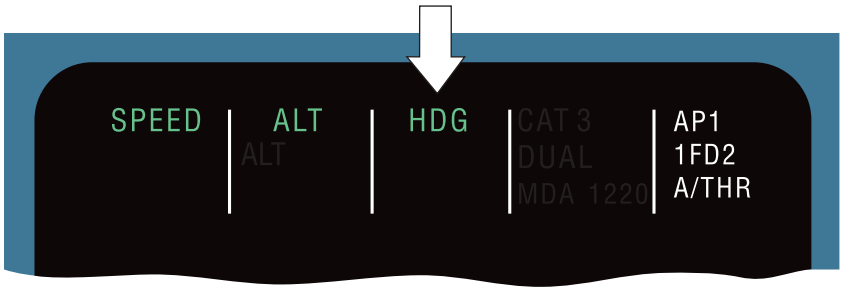
These actions automatically result in HDG mode.

Managed Lateral Mode (continued)

NAV Mode Indications

When the NAV mode is not engaged, the flight plan on the ND is depicted as a dashed green line. The line remains dashed until the NAV mode engages. At that time, the F-PLN becomes a solid green line. A typical sequence is shown below

.



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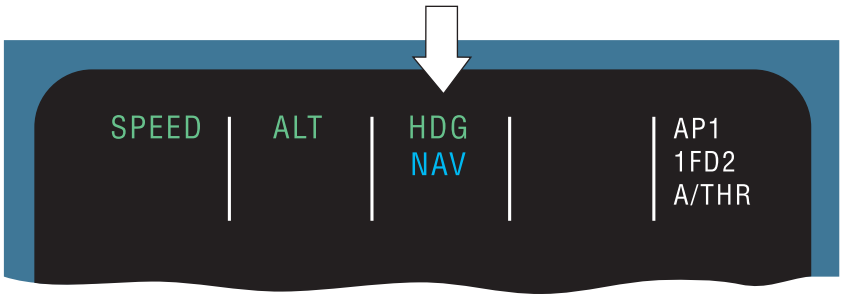

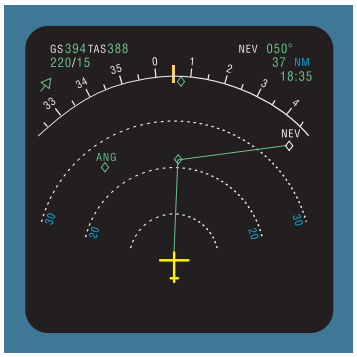

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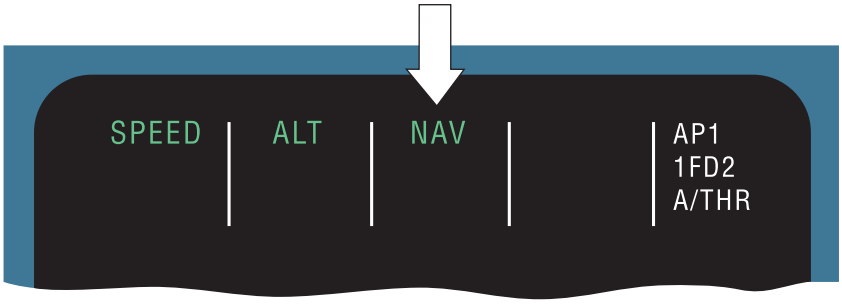

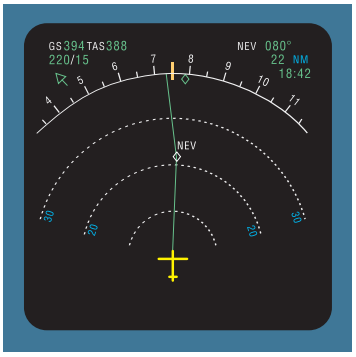

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LOC Lateral Mode

LOC Mode

The localizer (LOC) lateral guidance mode is used to track localizer front course signals.

The FCU LOC pb couples the flight guidance system to the localizer signal only. The FCU APPR pb couples the localizer and the glide slope (the APPR pb is discussed in detail in the Common Modes section later in this chapter).

The LOC mode is the only lateral mode that couples the lateral flight guidance to an external (localizer) signal. In all other cases, including VOR, NDB, and RNAV approaches, the lateral guidance is based on a flight plan segment using FMS navigation. It is not possible to couple the lateral guidance to VOR or NDB signals.

Note: The LOC mode cannot be used for localizer back course approaches.

The LOC mode is also used for LDA approaches (without glideslope).

LOC* Mode

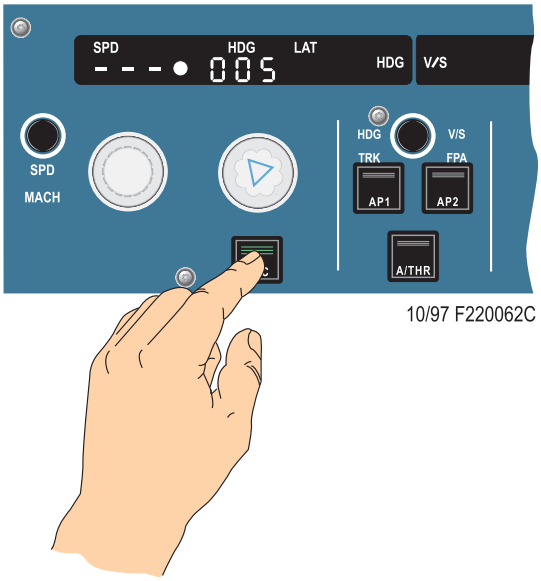
The LOC* mode is a sub mode that occurs during localizer capture. It is an indication that the localizer intercept is in progress but is not yet completed.

LOC Lateral Mode (continued)

Arming

The LOC mode is armed by pressing the FCU LOC pb or the APPR pb (refer to Common Modes, discussed later in this chapter), provided the following conditions are met:

- an ILS frequency is tuned, and
- TAKEOFF or GO-AROUND modes are not engaged.



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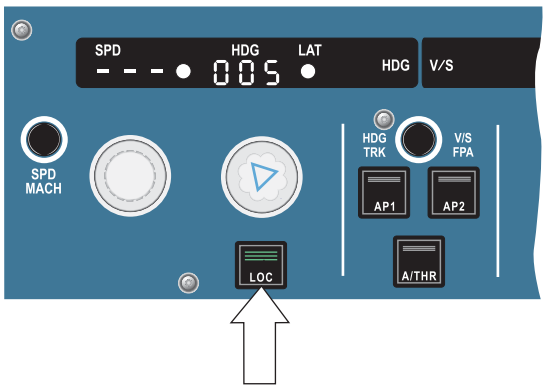
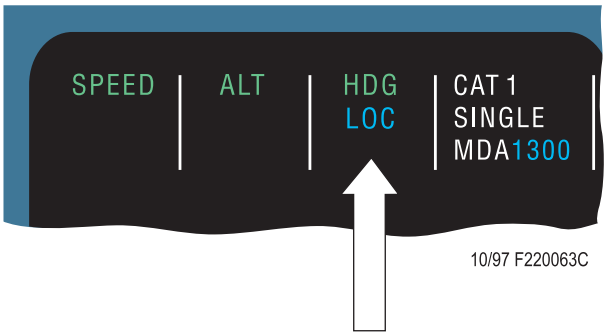
The pilot can recognize that the LOC mode has been selected by an illuminated FCU LOC pb and a blue armed LOC indication on the FMA. In the example below, the aircraft is on a heading, with the LOC mode armed.





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Disarming

The LOC mode can be disarmed by:

- depressing the illuminated FCU LOC pb,
- pulling or pushing the FCU HDG (TRK) knob (except when the LAND mode is engaged), or
- engaging the FMS go-around mode.

LOC Lateral Mode (continued)

LOC Mode ND Indication

If the aircraft is on a heading (or track) en route to the localizer, the green ND flight plan line is dashed. If the NAV mode is engaged, the green ND flight plan line is solid. In either case, the ND flight plan line becomes solid when the localizer is captured. The FMA must be referenced to verify that the engaged lateral mode is LOC as ND indications are identical to the NAV mode.

LOC Mode Operations

When the LOC mode is armed prior to capturing the localizer, the flight guidance maintains the previously selected guidance (heading, track, or managed navigation). Once the localizer has been captured, the previous guidance mode is ignored, regardless of the current flight plan. For example, if proceeding to a localizer and a procedure turn is in the flight plan, the procedure turn will not be flown if the localizer is captured prior to the start of that turn.

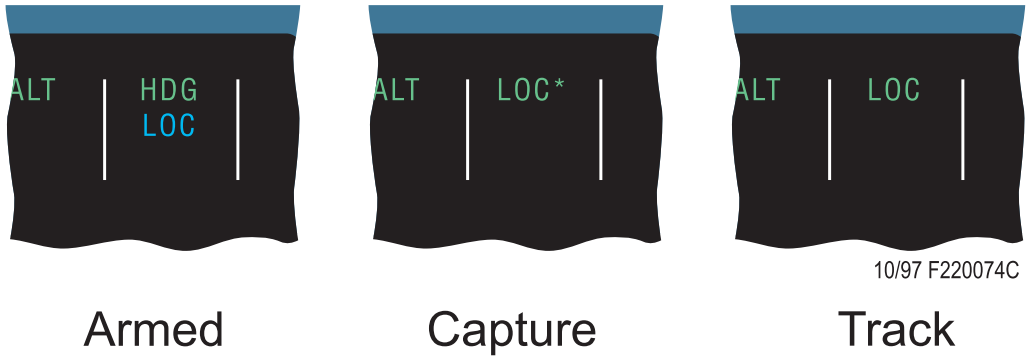
The flight director roll bar commands a localizer intercept. If an autopilot is engaged, the autopilot wil capture and track the localizer.

Note: Delta A319/320 aircraft are not authorized to conduct back course approaches.

Note: It is not possible to use the LOC pb to track the localizer signal during a fully managed approach. FINAL vertical managed mode and LOC mode cannot be used together. The pilot must manually select vertical guidance modes when using the LOC pb (e.g., use the V/S mode).

Diagram

An example FMA sequence associated with the LOC mode is shown below.



Vertical Guidance Modes

General

Vertical modes provide flight path guidance to an altitude selected on the FCU. Selected vertical guidance modes follow pilot inputs on the FCU. Selected modes always have priority over managed modes.

Managed vertical guidance is computed by the FMS along the pilot created flight plan and vertical profile.

During an approach, vertical flight guidance can be automatically provided by using database vertical approach data, e.g., FINAL vertical mode.

Level Change Principles

Altitude can be directly controlled by the pilot by selecting modes and altitudes with the FCU. Altitude can also be managed by programming altitude constraints at flight plan waypoints (refer to chapter 34, MCDU Operations) and allowing the FMS to manage altitude constraints as the flight plan sequences.

Selected Vertical Modes

Two actions must be taken before vertical guidance is provided to a different altitude. The pilot must:

- select the new altitude with the FCU ALT knob (the new altitude remains in the FCU altitude window indefinitely), and
- select a vertical mode on the FCU (pull the ALT knob, pull the V/S-FPA knob, or push the EXPED pb).

Managed Vertical Modes

Vertical constraints must be programmed at flight plan waypoints (refer to chapter 34, MCDU Operations). The aircraft must be on the flight plan route (NAV mode active) for managed vertical modes to function. To change altitude, two actions are required. The pilot must:

- select the new altitude with the FCU ALT knob (the new altitude remains in the FCU altitude window indefinitely), and
- push the FCU ALT knob. The aircraft crosses each waypoint to comply with the constraint altitude. A climb automatically occurs to the next altitude constraint after the waypoint is passed. If in a descent, the descent path is automatically computed so that the aircraft descends through the constraint altitude as the waypoint is passed, without a level off.

Vertical Guidance Modes (continued)

Interaction With Autothrust

The autothrust mode is directly related to the vertical mode (when autothrust is active). A change in the vertical mode usually results in a change in the autothrust mode.

The vertical modes and corresponding autothrust modes are shown in the table below.

Vertical Mode	Autothrust Mode
V/S, FPA **ALT*, ALT** **G/S*, G/S** **FINAL** **or** **All APs and FDs OFF** **or** **DES** **(geometric and repressurization paths)**	**SPEED/MACH**
CLB **OP CLB** **EXP CLB**	**THR CLB**
DES **(idle path and when above the path)** **OP DES** **EXP DES**	**THR IDLE**
SRS	**MAN FLEX or MAN TOGA**
FLARE (autoland only)	**THR IDLE**

Autothrust modes using fixed thrust (e.g., climb) are identified with a THR annunciation on the FMA (e.g., THR CLB). Autothrust modes using manually controlled thrust (e.g., TOGA) are identified with a “MAN” annunciation on the FMA.

Selected Vertical Modes

Open Climb

The open climb (OP CLB) mode is used when climbing directly to an altitude without honoring flight plan altitude constraints. In the OP CLB mode, the desired speed is held with pitch and the autothrust system commands CLB thrust. There is no FCU indication of the OP CLB mode. The FMA must be referenced to confirm OP CLB mode engagement.

Note: If the altitude change is less than 1,200 feet, a vertical speed of 1,000 fpm is used. The FMA indications do not change.

In the OP CLB mode, aircraft speed has priority. For example, manually increasing thrust to TOGA would increase the pitch attitude and rate of climb, but the airspeed would remain constant.

Engagement

If the FCU altitude is higher than the current altitude, the OP CLB mode is manually engaged by the following actions:

- pulling on the ALT knob, or
- pulling on the SPD/MACH knob if EXP CLB mode is active (refer to EXP CLB mode, this chapter).

The mode is automatically engaged in the following cases:

- after takeoff at the acceleration altitude if the managed climb (CLB) mode does not engage (refer to CLB Mode, this chapter),
- when managed CLB mode is disengaged due to loss of managed navigation (refer to CLB mode, this chapter).

Disengagement

OP CLB mode disengages whenever any other vertical mode is engaged.

Selected Vertical Modes (continued)

Open Descent

The open descent (OP DES) mode is used when descending directly to an altitude without honoring flight plan vertical constraints. In the OP DES mode, the desired speed is held with pitch and the autothrust system commands idle thrust. The thrust remains at idle until the FCU altitude is reached. The FMA must be referenced to confirm OP DES mode engagement.

In the OP DES mode, aircraft speed has priority. For example, manually extending the speed brakes would lower the pitch attitude and increase the rate of descent, but the airspeed would remain constant.

Warning

If the pilot is manually flying the aircraft in the OP DES mode, and does not follow the flight director, airspeed may decrease or increase significantly.

Use of OP DES mode is prohibited at low altitudes (refer to Vol. 1, L10).

The pilot must follow the flight guidance in the OP DES mode. For example, if an OP DES to 10,000 is selected and the pilot manually levels off at 15,000 (without changing the FCU altitude or vertical mode), the autothrust mode remains in IDLE. This causes the speed to decrease until the OP DES mode reverts to V/S (at approximately V_{LS}). Auto reversions are discussed in detail later.

Engagement

If the FCU altitude is lower than the current altitude, the OP DES mode is manually engaged by the following actions:

- pulling on the ALT knob, or
- pulling on the SPD/MACH knob if EXP DES mode is active (refer to EXP DES mode, this chapter).

Disengagement

This mode disengages whenever any other vertical mode is engaged.

Selected Vertical Modes (continued)

Vertical Speed-Flight Path Angle

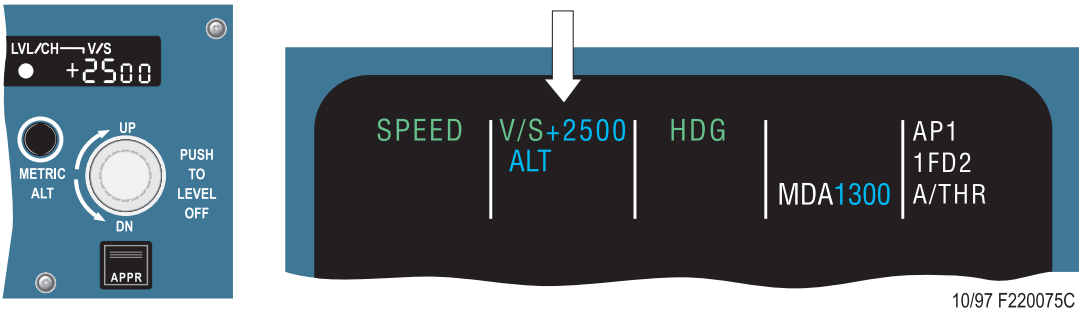
The pilot can select either a Vertical Speed (V/S) or Flight Path Angle (FPA) reference by using the HDG-V/S /TRK-FPA pb on the FCU. This pb also changes the PFD flight director symbology.

If HDG-V/S is selected, the corresponding vertical mode is V/S. If TRK-FPA is selected, the corresponding vertical mode is FPA. The FPA mode provides guidance to a desired angle relative to the horizon.

When V/S (FPA) mode is engaged, the autothrust mode is SPEED.

The V/S (FPA) FCU window is dashed except when the mode is engaged. However, a desired value may be preset for a short period of time. When engaged, V/S (FPA) is shown with a plus or minus sign indicating a climb or descent.

The V/S mode can be recognized by V/S in the FCU window and V/S on the FMA. V/S is displayed on the FCU using four digits, in feet/minute, with a “+” or “-” symbol as appropriate.



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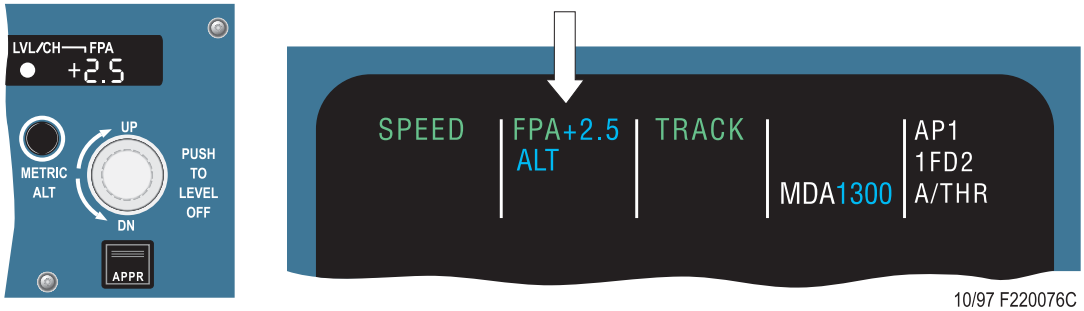
The FPA mode can be recognized by FPA in the FCU window and FPA on the FMA. FPA is displayed in the FCU using two digits, in degrees and tenths, with a “+” or “-” symbol as appropriate.



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Warning

It is possible to confuse V/S and FPA FCU indications. The FMA and PFD flight director indications must be used to confirm desired modes.

Note: When V/S (FPA) is selected to “0,” or the V/S knob is pushed, the aircraft levels off. On the FMA, V/S +0 is displayed. This indicates that altitude hold flight guidance is displayed. The reference altitude is determined by the aircraft altitude at level off and is not related to the FCU selected altitude. A V/S (FPA) of “0” also is displayed on the FCU.

Selected Vertical Modes (continued)

Vertical Speed-Flight Path Angle (Continued)

Engagement

V/S (FPA) is manually engaged by the following actions:

- pulling or pushing on the FCU V/S (FPA) knob,
- engaging an autopilot or flight director without either being previously engaged (this is the default vertical flight guidance mode),
- modification of the selected altitude when in ALT* (refer to Vertical Mode Reversions, this section), or
- when a vertical guidance mode is engaged (e.g., OP CLB) and the FCU altitude is changed in an illogical manner. This would occur, for example, if an altitude below the aircraft is selected while climbing (refer to Vertical Mode Reversions, this chapter).

The V/S (FPA), when engaged, is equal to the current aircraft vertical speed (or FPA). V/S (FPA) is automatically engaged by the following actions:

- when G/S capture or track modes are lost (loss of G/S or LOC signal, or de-selection of the LOC mode),
- when DES or FINAL modes are disengaged due to loss of managed navigation, and
- when reaching the MDA in FINAL mode.

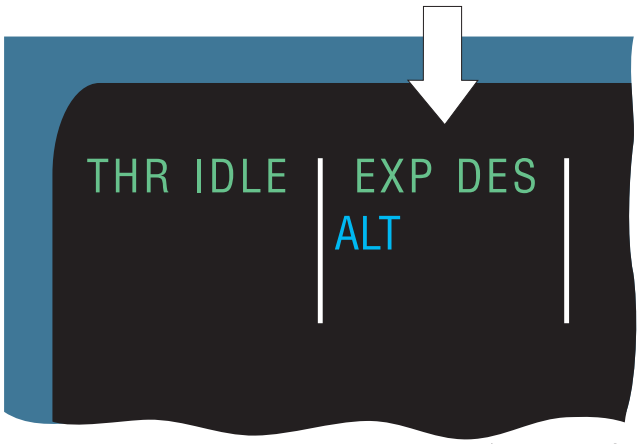
Disengagement

This mode disengages whenever any other vertical mode is engaged.

Note: The TRK FPA display automatically switches to HDG V/S when a go around is initiated.

Expedite Modes

The FCU Expedite (EXPED) pb is used to engage the expedite climb (EXP CLB) or expedite descent (EXP DES) mode. The expedite modes engage managed speeds. The pilot can recognize that an expedite mode is active by the illuminated EXPED pb on the FCU, and a green EXP CLB or EXP DES annunciation on the FMA.



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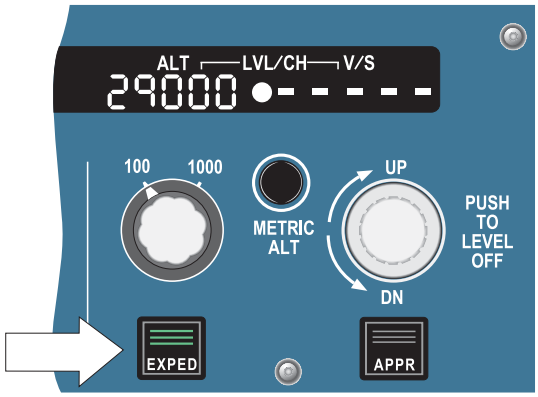

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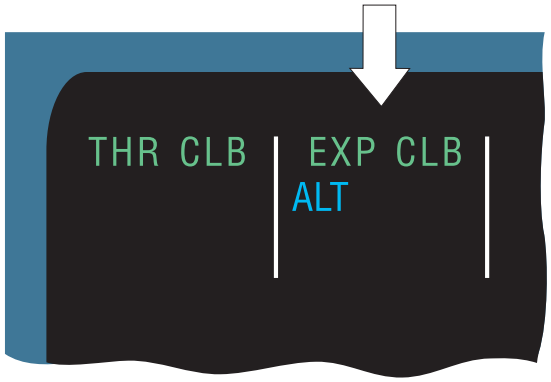
Selected Vertical Modes (continued)

Expedite Modes (Continued)

If the FCU altitude is above the current aircraft altitude, an expedite climb is commanded to the FCU altitude. If the FCU altitude is lower than the current altitude, an expedite descent occurs. Both expedite modes ignore all flight plan speed limits, speed constraints, and altitude constraints. Expedite modes cannot be engaged if LAND mode is active during an approach.

Expedite Climb

Expedite climb commands a pitch attitude corresponding to green dot airspeed, and climb thrust (with autothrust active). The FMA will indicate EXP CLB.



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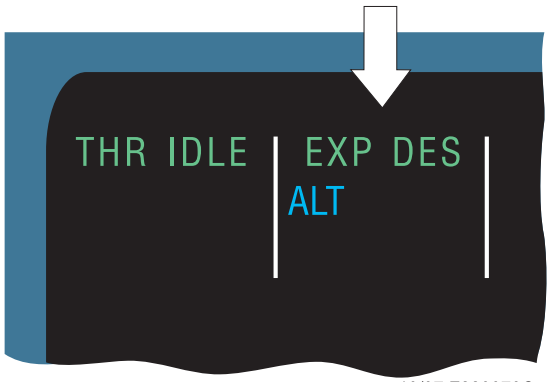
The use of EXP CLB is not recommended above FL250.

Note: If the flaps/slats are extended, the EXP CLB mode commands the appropriate maneuvering speed (S, F, or V_{APP}).

Expedite Descent

Expedite descent commands a pitch attitude corresponding to 340 knots/0.8 Mach and idle thrust (with autothrust active). The FMA will indicate EXP DES.



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The EXP DES mode does not honor speed limits, speed constraints, or other vertical constraints. If the FCU altitude is selected below 10,000 feet, for example, the speed remains at 340 KIAS during the descent.

The flight guidance will attempt to limit aircraft speed in the EXP DES mode to V_{MAX}. If the landing gear is extended, for example, a maximum speed of 280 KIAS is commanded.

Selected Vertical Modes (continued)

Expedite Modes (continued)

Disengagement

An expedite mode will disengage when the FCU altitude is captured (e.g., ALT*) or by an automatic reversion (refer to Automatic Reversions, this section).

To manually disengage an expedite mode, another vertical mode must be engaged. Other vertical modes are:

- OP CLB or OP DES mode (pull the ALT knob),
- CLB or DES mode (push the ALT knob),
- V/S (or FPA) mode (pull or push the V/S knob), or
- select SPD/MACH mode (pull the SPD/MACH knob) (this also results in OP CLB or OP DES as appropriate). Expedite modes control pitch and speed. Therefore, selecting a speed disengages the expedite mode.

Note: Pushing an illuminated EXPED pb has no effect.

Managed Vertical Modes

General

Managed vertical guidance is computed by the FMS along the flight plan and vertical profile you create (refer to chapter 34, Navigation: MCDU Operations). Managed vertical guidance requires the aircraft to be following managed lateral guidance (NAV mode engaged) as each vertical constraint is associated with a waypoint on the flight plan. The managed vertical modes are managed climb (CLB) and managed descent (DES) modes.

If the aircraft is maneuvered off of the managed navigation guidance, vertical guidance will revert to selected guidance, e.g., selecting a heading causes the CLB mode to revert to the OP CLB mode.

Speed Limits

Speed limits defined in the MCDU are always associated with an altitude and can be modified or deleted (refer to chapter 34, MCDU Operations). The default value is 250 knots at 10,000 feet.

Speed limits are defined as “at or below” the specified speeds when at or below that altitude. Speed limits are not associated with flight plan waypoints and therefore do not require managed lateral guidance.

Managed Vertical Modes (continued)

Speed Constraints

The pilot can enter a speed constraint into the flight plan at any flight plan waypoint (refer to chapter 34, MCDU Operations). Speed constraints are defined as “at or below” the specified speeds. Unlike speed limits, which are associated only with an altitude, speed constraints are associated with waypoints. The aircraft's flight path must cross the associated waypoint for the speed constraint to be honored.

Speed constraints are automatically honored only when managed NAV and managed speed modes are engaged. For example, if the clearance requires the aircraft to cross point XYZ at 210 KIAS, the speed constraint is entered at XYZ. Unless the aircraft flight path crosses point XYZ in managed NAV and managed speed, the speed constraint is not automatically honored.

Altitude Constraints

The pilot can enter an altitude constraint into the flight plan at any waypoint (refer to chapter 34, Navigation: MCDU Operations). Altitude constraints can be entered to cross the waypoint:

- at the defined altitude,
- at or above the defined altitude, or
- at or below the defined altitude.

Data base procedures can contain an altitude constraint between two altitudes, e.g., a STAR may require that the altitude at XYZ is between 7,000 and 11,000 feet. This type of altitude constraint is called a window.

Once entered, the flight guidance will honor altitude constraints only when both managed lateral and vertical modes are engaged. For example, the pilot can enter a restriction during a descent to cross point ABC at or below 17,000. Unless the aircraft flight path crosses point ABC in managed NAV the altitude constraint is ignored.

Altitude constraints may or may not be entered into the flight plan when certain data base procedures are selected. The pilot must always verify data base altitude constraints.

FCU Altitude Priority

The altitude selected in the FCU altitude window always has priority over altitude constraints entered on the MCDU. For example, the aircraft is climbing and an altitude constraint at waypoint XYZ is entered at FL370. The FCU altitude is selected to FL330 due to an ATC constraint. The aircraft does not climb above FL330 until the FCU altitude is changed. The same FCU priority exists for descents.

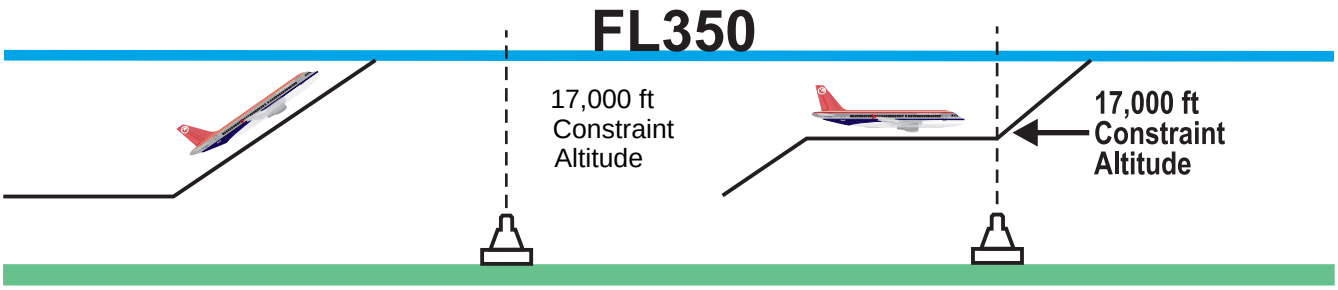
Managed Vertical Modes (continued)

Managed CLB Mode

The managed CLB mode is similar to the OP CLB mode. The aircraft climbs at the same speeds and uses the same autothrust mode(CLB). If no altitude constraints are entered in the flight plan, the performance of both modes is identical. If an altitude constraint is entered via the MCDU (refer to chapter 34, Navigation: MCDU Operations), the aircraft levels off to meet that constraint and maintains that altitude until passing the waypoint associated with the constraint.

Managed NAV mode must be engaged prior to activating the managed CLB mode.

A comparison between the OP CLB and CLB modes is shown below



OP CLB Mode

CLB Mode with Altitude Constraint

The CLB mode is engaged by pushing on the FCU ALT knob. However, if the lateral NAV mode is not already engaged, pushing has no effect. The pilot can recognize CLB mode by noting the green FMA CLB annunciation.

During the climb, if an altitude constraint is in the flight plan and is lower than the FCU altitude, the following is displayed on the PFD:

- an armed magenta ALT FMA annunciation, and
- a magenta altitude constraint on the PFD altitude indication

Managed Vertical Modes (continued)

Managed CLB Mode (continued)

If the constraint altitude is equal to or higher than the FCU altitude, all PFD annunciations are blue. A magenta FMA annunciation indicates that the aircraft will level off at the constraint.

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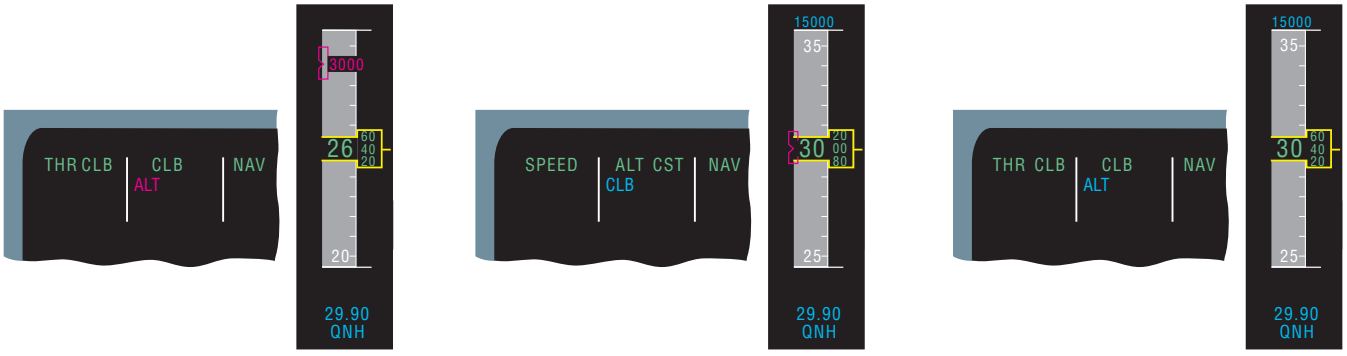
Constraint Sequencing

When the aircraft levels off at the altitude constraint, CLB mode is rearmed and engages when the waypoint associated with the altitude constraint is passed. If an immediate climb is desired, a selected vertical mode may be engaged. A typical CLB mode FMA sequence showing a climb to an altitude constraint of 3,000 feet, level off, and subsequent climb to an FCU altitude of 15,000 feet is shown below. If the aircraft is level at the constraint, a green ALT CST (altitude constraint) FMA annunciation is displayed. Also shown are the associated PFD altitude indications

.



Constraint Armed | **Altitude At Constraint** | **FCU Altitude Armed**
(after passing waypoint with constraint)

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Note: If the aircraft will not level off at the constraint, only the blue FCU altitude indications are displayed.

Managed Vertical Modes (continued)

Managed CLB Mode (continued)

Disengagement

CLB mode is manually disengaged by the following actions:

- engaging any other vertical mode, or
- pulling on the HDG (TRK) knob (managed NAV is required for the CLB mode). This results in OP CLB mode, e.g., when vectored off the flight plan, the vertical constraint is no longer honored.

Note: In the example above, if the aircraft is vectored back to the flight plan route, the CLB mode will not re-engage when NAV mode is engaged. Unless the pilot manually re-engages the CLB mode, the OP CLB mode remains engaged and all altitude constraints are ignored.

CLB mode is automatically disengaged when entering a flight plan vertical or lateral discontinuity (refer to chapter 34.30, MCDU Operations).

In this case the OP CLB mode will engage. This will occur after takeoff at the acceleration altitude, for example, if the NAV mode is not engaged.

CLB Mode Override

The pilot can stop the climb by changing the FCU altitude to the current aircraft altitude.

To re-engage the CLB mode, the pilot must select a higher altitude and push the FCU ALT knob.

A level off may also be achieved by selecting the V/S (FPA) to zero, or pushing on the V/S (FPA) knob. Either of these actions results in an FMA V/S +0 annunciation. The CLB mode is re-engaged by pushing the FCU ALT knob.

Managed Vertical Modes (continued)

Managed DES Mode

The managed DES mode is designed to descend the aircraft along a preplanned path. The path is constructed with altitude and speed constraints entered at flight plan waypoints (refer to 34.30, MCDU Operations). In the OP DES mode, aircraft speed has priority and the aircraft descends at idle thrust, while maintaining the desired speed. In the DES mode, the planned descent path has priority over speed. Airspeed can automatically vary within an allowable speed range and autothrust will vary thrust so that the aircraft remains on the path. The DES mode is designed to reduce pilot workload during descents. The managed DES mode attempts to maximize fuel economy by keeping the aircraft as high as possible, for as long as possible, and attempting to achieve a descent path using idle thrust. As a result, the descent path is designed to:

- reach an at altitude constraint as the aircraft reaches the associated waypoint.
- reach at or above or at or below altitude constraints at the highest altitude consistent with all constraints at later waypoints.

If further descent is allowed beyond the constraint waypoint, the descent continues without a level off. Each FMGC independently computes a descent path. This may result in depicted differences on each PFD's pitch bar.

Warning

If the pilot is manually flying the aircraft in the DES mode, and does not follow the flight director, airspeed may decrease or increase significantly.

Use of DES mode is prohibited at low altitudes (refer to COM Limitations section).

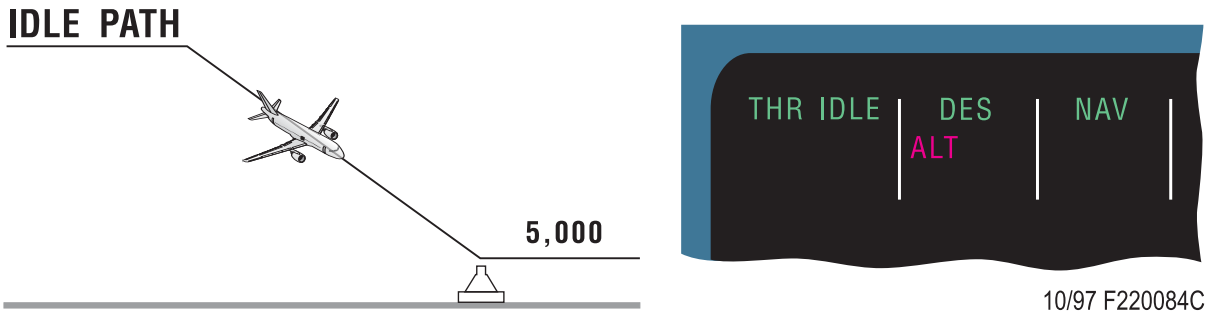
If the aircraft passes the computed Top of Descent (T/D) point, a DECELERATE message is displayed on the PFD. The DES mode has three types of segments: the idle path, the geometric path, and the repressurization path. In addition, the path is modified as required to account for decelerations to meet speed limits, speed constraints, holding speeds, etc. When the DES mode is engaged, the autothrust mode automatically varies between IDLE and SPEED (MACH) as required to maintain the desired speed. Switching between the three types of descent paths is automatic and no direct indication of the type of path engaged is provided.

Managed Vertical Modes (continued)

Managed DES Mode (continued)

Idle Path

The descent path associated with idle thrust is the optimum path, and the DES mode will always attempt to reach this path when conditions allow. Thrust is normally fixed at idle (plus a small margin), and the autothrust mode is IDLE. This idle path uses a thrust slightly above idle to allow for errors in the calculations, subsequent use of engine anti-ice, or unexpected wind conditions. However, thrust will increase as necessary to maintain the desired speed



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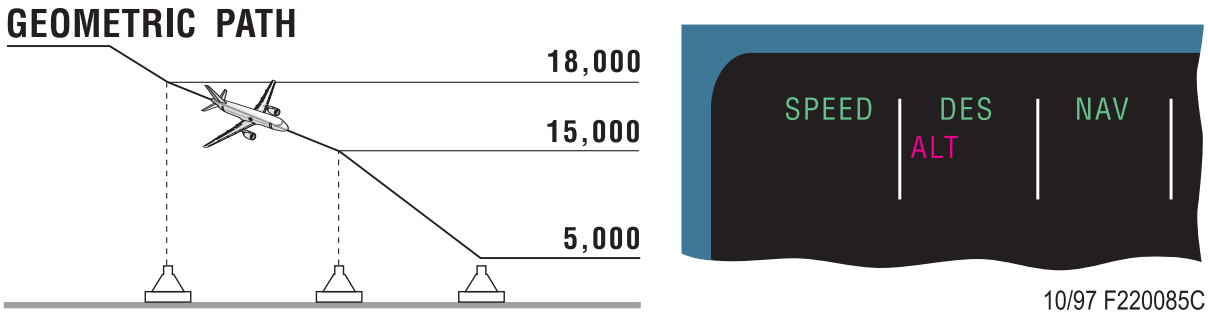
Geometric Path

If altitude constraints occur which require the use of thrust above idle, a geometric path is computed. The geometric path may consist of many different segments at different descent angles as required to meet all constraints. During this segment, pitch varies to maintain the computed descent path and the autothrust mode is SPEED (MACH)



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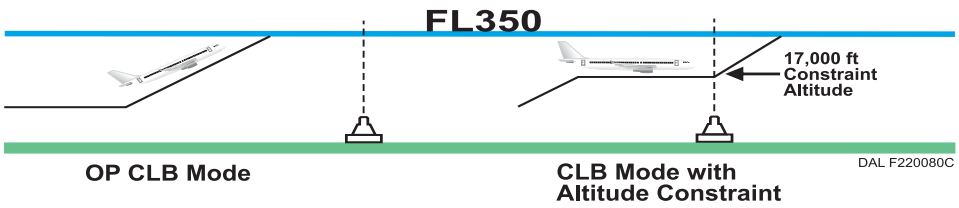
Managed Vertical Modes (continued)

Managed DES Mode (continued)

Repressurization Path

The pilot can select a repressurization schedule (via the MCDU) which repressurizes the aircraft at a slower rate. The slower repressurization schedule requires the aircraft to start the descent at an earlier point when cruising at higher altitudes. This repressurization path results in a more gradual descent and is similar to a geometric path. During this segment, pitch varies to maintain the computed descent path and the autothrust mode is SPEED (MACH).



Engagement

The DES mode will engage only when either the NAV, LOC*, or LOC modes are engaged. The DES mode is engaged by pushing on the FCU ALT knob with a lower altitude in the FCU altitude window.

The DES mode cannot be manually armed. The aircraft immediately starts the descent when the FCU altitude knob is pushed. If the aircraft has not reached the top of descent point (e.g., the aircraft is below the path), a 1,000 ft/min descent is initiated.

The pilot can recognize that the DES mode is engaged by noting the FMA DES annunciation and an illuminated FCU managed guidance light in the FCU altitude window.

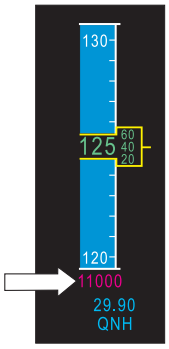
Managed Vertical Modes (continued)

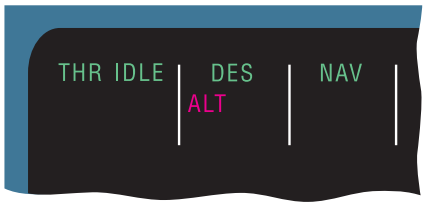
Managed DES Mode (continued)

If the altitude constraint is above the FCU altitude and a level off at the constraint is predicted, the following is displayed on the PFD:

- an armed magenta ALT annunciation, and
- a magenta altitude on the PFD altitude indicator

The magenta color indicates that a level off is planned at the constraint altitude. After level off at the constraint, an ALT CST (altitude constraint) FMA indication is displayed in green.





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If the altitude constraint is below or equal to the FCU altitude (e.g., a level off at the constraint is not predicted), the FMA ALT annunciation and the PFD target altitude indication are blue.

If the DES mode is engaged (by pushing the FCU altitude knob) and the aircraft is prior to the calculated top of descent (T/D) point, a 1,000 ft/min descent starts immediately with a constant vertical speed until intercepting the computed descent path. The autothrust mode is SPEED. Once intercepting the descent path, either the autothrust SPEED mode or IDLE mode is engaged, depending on the computed descent path.

If the DES mode is engaged and the aircraft is at or beyond the top of descent point when the descent is initiated, a descent starts immediately with IDLE thrust commanded.

Pushing the FCU altitude knob when the NAV, LOC*, or LOC modes are not engaged has no effect.

Managed Vertical Modes (continued)

Managed DES Mode (continued)

Constraint Sequencing

The DES mode computes a descent path such that the aircraft reaches the altitude constraint (± 250 ft) as the aircraft reaches the constraint waypoint.

The FCU altitude always has priority and the aircraft will not descend below the FCU altitude if the constraint altitude is lower.

Note: If the altitude constraint is an at or above constraint, the descent path is computed so that a constant descent path is maintained during subsequent constraints. In this case, this may result in the aircraft passing well above the at or above constraint.

Disengagement

The DES mode is manually disengaged by the following actions:

- engaging any other vertical mode, or
- pulling on the HDG (TRK) knob (managed NAV, LOC*, or LOC modes are required for the DES mode). This results in V/S mode at the current vertical speed.

The DES mode is automatically disengaged:

- when ALT* mode engages (it will automatically re-arm if appropriate), or
- when entering a flight plan discontinuity.

In both of these cases, the V/S mode engages, preventing a pitch change.

DES Mode Override

The pilot can stop the descent by changing the FCU altitude at any time. A level off may also be achieved by pushing in the V/S (FPA) pb which sets the V/S (FPA) to zero.

To re-engage the DES mode, a lower altitude is selected and the FCU ALT knob is pushed.

DES Mode in Holding

When in a holding pattern, the DES mode commands a vertical speed of 1,000 ft/min. The autothrust mode is SPEED (MACH). Vertical constraints in the flight plan after the holding pattern will be honored.

Managed Vertical Modes (continued)

Path Control

The DES mode maintains the computed path with pitch, similar to an ILS glide slope. Autothrust will increase or decrease thrust as necessary to maintain the target speed.

Below The Path

When below the path, autothrust increases thrust as necessary (SPEED or MACH mode) and the DES mode commands:

- a minimum of a 1,000 ft/minute descent until intercepting the path when on an idle path or repressurization path (i.e., when the descent from cruise altitude is started before the top of descent point), or
- a minimum descent angle equal to half of the computed angle when on a geometric path. The minimum rate of descent in this case is 500 ft/minute until intercepting the path (i.e., if on a profile descent and vectored off of the path and then back onto the path at an altitude lower than the computed path).

In either case, airspeed is allowed to decrease to the minimum allowable speed in an attempt to maintain the descent path (refer to Speed Control in DES mode, discussed next).

Above The Path

When above the path, the DES mode commands IDLE thrust.

If the aircraft is still above the path, managed airspeed is automatically increased from the target speed towards the maximum allowable speed. The maximum allowable speed is displayed by a speed bracket on the PFD airspeed indicator (refer to Speed Control in DES mode, discussed next). The speed increase will only occur when in managed speed.

If the aircraft is still above the path, a PFD ADD DRAG message is displayed. This message indicates that the use of at least 1/2 speedbrakes is required until reaching the constraint waypoint (refer to Speedbrakes, discussed later in this section).

If the use of 1/2 speedbrakes does not return the aircraft to the path, no additional automatic increase in airspeed occurs. A MCDU “ALTITUDE ERROR” and/or “SPEED ERROR” message is displayed.

Note: When significantly above the descent path and at idle thrust, selecting a speed higher than the maximum allowable managed speed increases the descent rate. Managed speeds can be resumed when the path is intercepted.

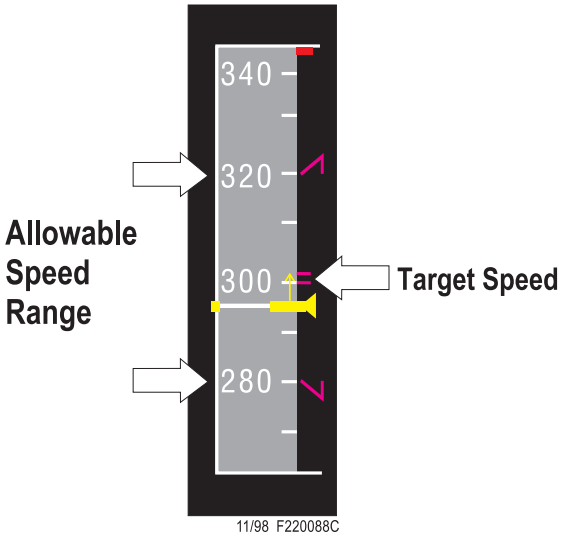
Managed Vertical Modes (continued)

Speed Control

The desired speed in the DES mode is controlled by the autothrust system (if active). Because the DES mode attempts to fly a preplanned path, variations in airspeed do not affect the angle of descent when on the path. Airspeed control in the DES mode is different between managed and selected speeds.

Managed Speeds

To minimize thrust changes, a ± 20 knot speed range is computed and the managed speed will vary within the allowable speed range. When above the path and at idle thrust, speed increases towards the upper limit. When below the path, speed decreases towards the lower limit. The allowable speed range is displayed as two magenta tic marks (at the target speed) and two magenta allowable speed range symbols, as shown below.



The maximum allowable speed decreases to five knots above the speed target when the speed target is a result of a speed constraint or speed limit. It is further limited by V_{MAX}, if applicable.

V_{mo} may be exceeded in the DES mode if the upper limit airspeed is near V_{mo} and atmospheric conditions cause a momentary increase in airspeed.

The minimum allowable speed is limited by maneuvering speed or V_{LS}, whichever is higher.

If any other vertical mode is selected (e.g., V/S), the allowable speed range disappears. A magenta target speed triangle will be displayed and the aircraft speed will return to this managed speed.

Managed Vertical Modes (continued)

Selected Speed

If speed is selected with the DES mode engaged, a blue triangle is displayed as usual on the PFD airspeed indicator. In this configuration, speed will not vary. However, the DES mode will vary thrust and/or command speedbrakes. As a result, if:

- on the path and the selected speed is:
  - increased, thrust increases to remain on the path.
  - decreased, thrust decreases towards idle. If the speed decrease is significant, the aircraft may go above the path, requiring the use of speedbrakes.
- below the path and the selected speed is:
  - increased, thrust increases and no change in the descent rate occurs.
  - decreased, thrust is reduced and no change in the descent rate occurs.
- above the path and the selected speed is:
  - increased, the thrust remains at idle. The descent rate increases and the aircraft converges towards the descent path.
  - decreased, the thrust remains at idle and the aircraft deviates further above the path.

Managed Vertical Modes (continued)

Speedbrakes

Speedbrakes should be used when the DES mode is engaged only when above the descent path. The use of speedbrakes increases the descent rate only when the aircraft is above the computed descent path. When on or below the path, the use of speedbrakes results in an increase in thrust.

The speedbrakes should be smoothly extended whenever the white PFD MORE DRAG message is displayed. The presence of this message indicates that at least 1/2 speedbrakes are required for the next altitude and/or speed constraint to be met.

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Whenever the PFD message is present, the FMS assumes that the pilot is using 1/2 speedbrakes. If speedbrakes are not deployed, the constraint(s) will be missed. The ND descent path intercept symbol depicts the path intercept point assuming that the speed brakes are deployed to 1/2.

If the speedbrakes are extended and the aircraft is on or below the path, thrust is increased to hold the target speed and descent path. No increase in descent rate occurs.

Note: No message is provided to remind the pilot to retract the speedbrakes once the constraint waypoint is passed. The green E/WD SPEED BRAKE memo pulses in amber when speedbrakes are no longer required and thrust exceeds a preset limit.

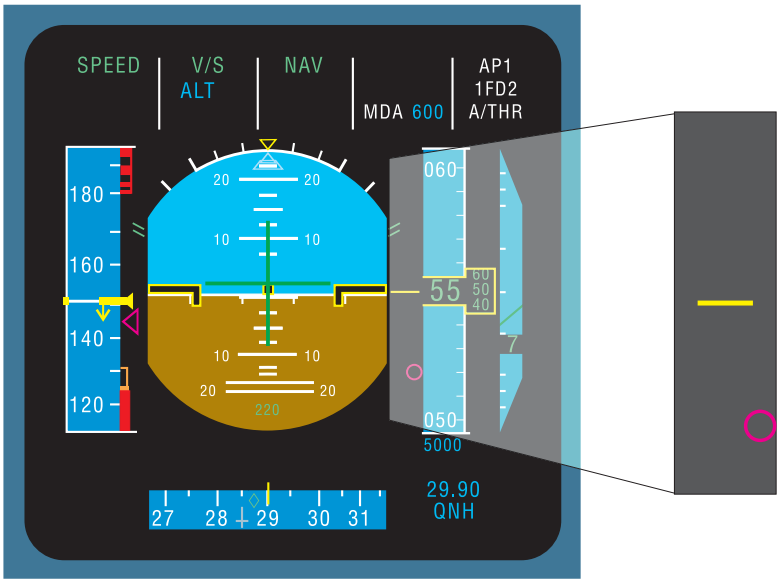
Managed Vertical Modes (continued)

Descent Path Indicator

The descent path indicator is displayed next to the altimeter and depicts the position of the vertical path at the aircraft's current location. The vertical position of the symbol directly relates to the altitude on the altimeter. For example, if the descent path indicator is located 200 feet below the current altitude, then the aircraft is 200 feet above the descent path.

Unlike the ILS glide slope indicator, the descent path indicator has the same sensitivity at very low altitudes as it does at high altitudes. The location of the descent path indicator does not necessarily correspond to the ILS glide slope, particularly when outside the glide slope intercept point. The descent path indicator is removed when the G/S* mode engages.

In the example shown, the aircraft is above the computed descent path.



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Note: Additional vertical deviation indications are provided on the ND and MCDU (refer to ch. 34, Navigation).

The descent path indicator is replaced by the VDEV indicator during an APPR NAV approach or if G/S* mode engages.

The descent path is normally constructed from 50 feet above the runway threshold and extends upwards at a predetermined angle. The descent path en route to the final approach segment is comprised of the segment types (idle path, geometric path, etc.) as previously described. The final approach angle is normally a 3.0° glide path when a VFR runway is entered in the flight plan. The descent angle during data base precision and non-precision approaches is computed using the constraint altitudes for that specific approach. These angles are displayed on the MCDU F-PLN page and will vary (as appropriate) for approaches to different runways.

Altitude Acquire/Hold Modes

Altitude Acquire Mode

The altitude acquire (ALT*) mode provides the transition between vertical modes and the altitude hold (ALT) mode. When the ALT* mode engages, the autothrust mode changes to SPEED.The ALT mode is automatically armed provided the following conditions are met:

- any climb or descent mode is engaged, or
- V/S (or FPA) mode is engaged and is converging towards the FCU altitude, e.g, the aircraft is below the FCU selected altitude and a climbing V/S has been selected.

If the ALT* mode is disturbed by changing the FCU altitude during the level off, the aircraft continues on its previous flight path at the vertical rate existing when it was disturbed (V/S mode is engaged). For example, if ALT* is engaged and:

- the FCU altitude is changed when leveling off during a climb the current V/S is commanded. (e.g., this may result in a very low rate of climb at less than climb thrust if the FCU altitude was changed when the aircraft had almost achieved level flight.)
- the missed approach altitude is set when leveling off at the MDA during a non-precision approach, the current V/S is commanded and the aircraft will descend through the MDA.
- the FCU altitude is changed during a descent level off, the rate of descent remains at the current V/S. This rate of descent may not be sufficient to comply with subsequent altitude restrictions. (e.g., this could occur when leveling off at a step down altitude during a non-precision approach).
- changing the altimeter barometric setting while in ALT* mode may result in a failure to capture the FCU altitude. Depending on the direction of change, it may result in a reversion to the V/S mode at the current V/S without an altitude capture.
- the speedbrakes are rapidly extended or retracted, an altitude overshoot may occur. This overshoot will self correct and is a result of limited FD/AP “g” authority in the ALT* mode. Overshoots can be avoided by avoiding rapid actuation of the speedbrakes in the ALT* mode.

These characteristics are avoided by monitoring the FMA when the FCU altitude is modified, especially when ALT* mode is engaged.

Warning

Airspeed protection (V_{LS}) is not provided in the ALT* mode. If an engine failure occurs in the ALT* mode, the pilot must take action to maintain a safe airspeed.

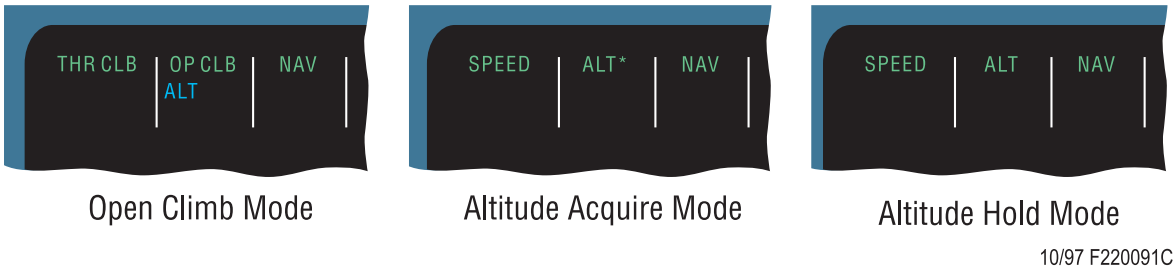
Altitude Acquire/Hold Modes (continued)

ALT Hold Mode

The ALT mode maintains a given altitude. The reference altitude can be:

- the FCU altitude (indicated by a green ALT on the FMA),
- the flight plan altitude constraint indicated by a green ALT CST on the FMA, or
- the altitude at which the V/S (or FPA) was set to zero (indicated by a green ALT on the FMA). For example, to level off at 1,000 feet AGL after takeoff with an engine failure, the climb may be stopped by pushing the V/S knob. In this case, the V/S mode remains engaged, however, ALT is displayed on the FMA.

The FMA annunciations associated with the ALT* and ALT modes are shown in the example climb sequence below.



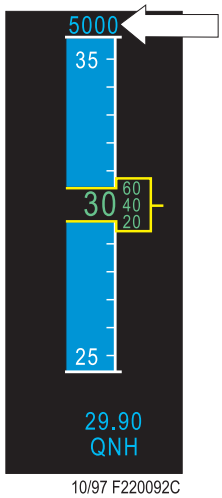
10/97 F220091C

Note: If the selected FCU altitude is same as the MCDU programed cruise altitude, the FMA annunciation is ALT CRZ.

The altitude at which the aircraft will level off is displayed on the PFD altimeter. If off scale, the level off altitude is depicted by a digital indication:

at the top of the scale for higher altitudes, or

at the bottom of the scale for lower altitudes.



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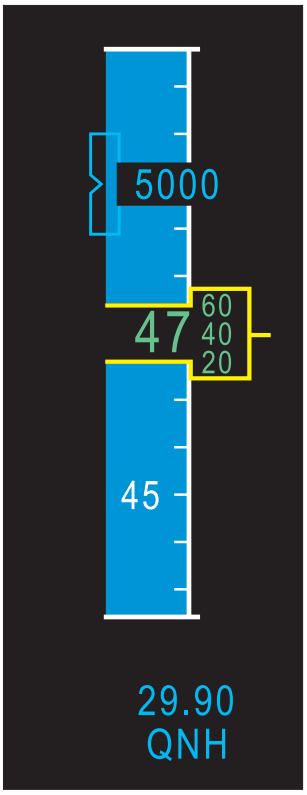
Altitude Acquire/Hold Modes (continued)

ALT Hold Mode (continued)

If within the altimeter scale indications, the level off altitude is depicted by a bracket. Level off indications are depicted.

in blue if equal to the FCU altitude, or

in magenta if associated with and altitude constraint.



10/97 F220093C

Note: The selected FCU altitude may inadvertently change when the FCU altitude knob is pulled or pushed. All altitude selections should be verified on the PFD after the vertical mode is engaged.

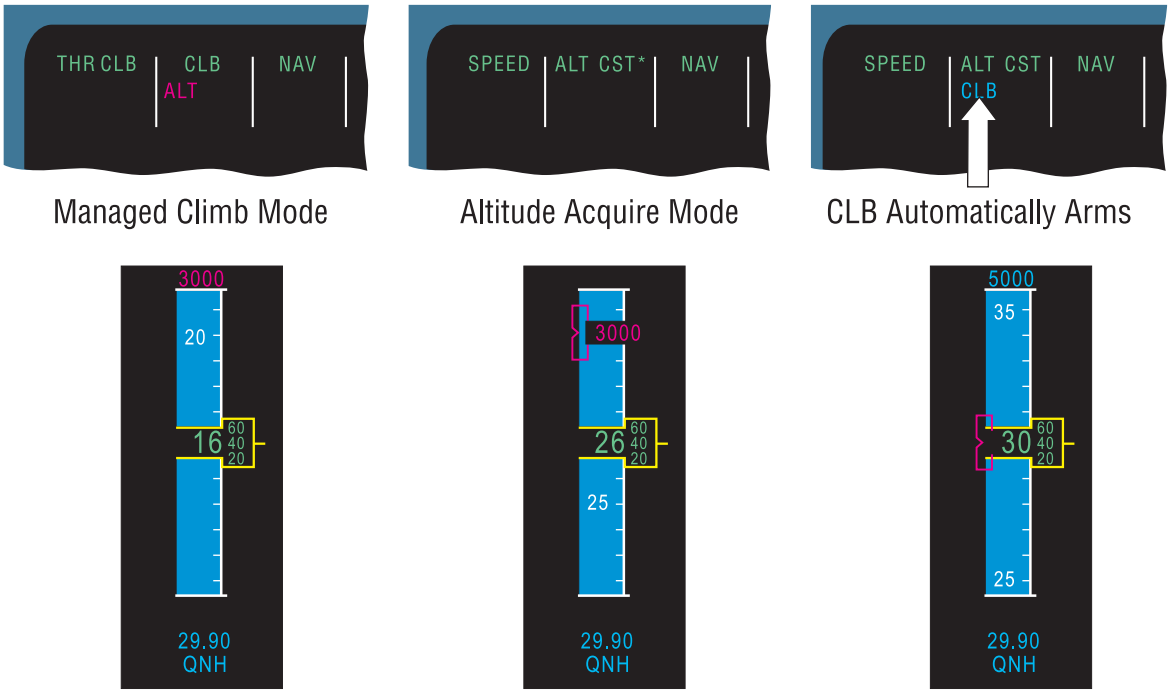
FCU Altitude Changes in ALT Mode

Once the ALT mode engages, the FCU altitude can be changed (without pushing or pulling the knob) without affecting the aircraft altitude. This allows a subsequent altitude to be preset. For example, a “descend at pilot discretion” altitude can be preset.

Altitude Acquire/Hold Modes (continued)

ALT and ALT* During Altitude Constraints

The ALT* mode functions in an identical manner during level off as a result of flight plan altitude constraints. If the level off is a result of a flight plan altitude constraint, the armed ALT annunciation on line 2 is displayed in magenta. The ALT* annunciation changes to ALT CST*. In the example below, an altitude constraint exists at 3,000 feet with the FCU altitude set to 5,000 feet.



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Once level at the altitude constraint, the FMA indication is ALT CST, with the CLB or DES mode automatically armed. This indicates that the climb or descent will continue once the constraint waypoint is passed.

ALT HOLD and Waypoint Sequencing

Certain flight plan waypoints are conditional waypoints in the lateral flight plan that require the aircraft to reach an altitude before turning. For example, a missed approach may require the aircraft to climb to 2,800' MSL before turning. If the FCU altitude is the same altitude, the aircraft may level off a few feet below this altitude due to ALT HOLD mode tolerances and this conditional altitude waypoint may not automatically sequence, preventing the turn. This condition requires pilot intervention (e.g., a manual turn using HDG mode).

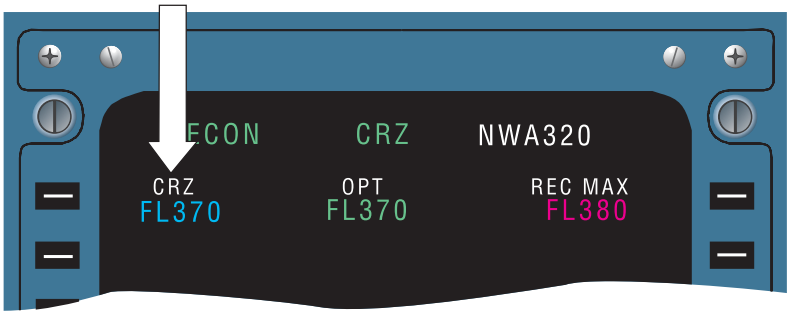
Altitude Acquire/Hold Modes (continued)

Soft Altitude Hold

The soft altitude hold mode allows the aircraft altitude to vary slightly when at the desired FMS cruise (CRZ) flight level. When the FCU altitude is selected to the same altitude as the FMS CRZ flight level, and the aircraft reaches that altitude, the soft altitude hold mode engages. The altitude can vary as much as 50 feet either side of the selected altitude. This minimizes thrust variations and improves fuel efficiency.

FCU Altitude

MCDU Cruise Altitude



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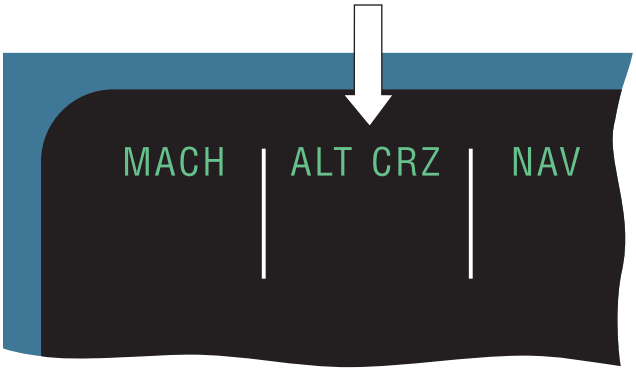
When the soft altitude hold mode engages “ALT CRZ” is displayed on the FMA.



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Once engaged, the FMS CRZ FL automatically follows the FCU altitude.

If the initial FCU cruise altitude is selected to an altitude lower than the MCDU CRZ altitude, the pilot must re-cruise the MCDU CRZ altitude if a long term level off is anticipated. The FMS flight phase stays in the climb phase until the aircraft reaches the MCDU CRZ altitude. For example, FL370 is the planned CRZ altitude. The aircraft is leveled off at FL330 due to turbulence. The MCDU CRZ altitude must be changed to FL330 to sequence the FMS to the cruise phase and engage the soft altitude hold mode.

Vertical Mode Reversions

Purpose

Vertical mode reversions occur when the active mode automatically changes to another mode as the aircraft approaches a flight envelope limit. Vertical Reversions will occur for one of three reasons:

1. Speed Protection
2. Loss of Managed Lateral mode
3. FCU Altitude Change Reversions

V/S Mode Automatic Reversions

In V/S, the selected vertical climb (or descent) has priority over the commanded speed. If an excessive V/S has been selected, the airspeed deviates from the desired value. The selected V/S is held until the aircraft speed envelope is reached. The vertical speed is then automatically adjusted to maintain approximately V_{LS} or V_{MAX} despite the V/S selected on the FCU.

If the autopilot is engaged and the aircraft is equipped with enhanced triple click capability, the triple click will be heard and the V/S target will pulsate and be boxed with a flashing amber rectangle. If the autopilot is not engaged, the FD will adjust to maintain V_{LS} but the triple click will not be generated and the V/S speed indication will not change.

For example, if the pilot selects a V/S with a rate of climb of 5,000 ft/min, the aircraft would not be able to sustain this rate of climb. When the aircraft has slowed excessively (airspeed approaching V_{LS}, the vertical speed will automatically be adjusted to maintain V_{LS}, which protects the flight envelope.

Conditions: V/S Mode Engaged and:	Consequences
High Rate Of Climb (Speed approaching V_{LS})	V/S will be adjusted to maintain approximately V_{LS}
High Rate Of Descent (Speed approaching V_{MAX})	V/S will be adjusted to maintain approximately V_{MAX}

Loss of Managed Lateral Mode

When flying with managed NAV engaged, the autopilot is flying the flight plan route laterally and can therefore honor any additional speed or altitude restrictions along the route. To do so, the pilot may utilize the CLB and DES vertical modes. However, if flying in a HDG mode, the FMS is unable to honor speed and altitude restrictions along the route of flight and therefore the CLB and DES modes are unavailable for use.

If either the CLB or DES mode is being utilized and managed NAV is lost (i.e. pilot selects a HDG mode), the CLB and DES modes are no longer available and will be forced to revert to another mode. CLB will revert to OP CLB and DES will revert to the current V/S. The pilot may then select another vertical mode (other than managed modes) if desired.

Vertical Mode Reversions (continued)

FCU Altitude Change Reversions

When the FCU altitude is changed, the engaged vertical mode does not change if the altitude change is in a logical direction. (e.g., If in OP CLB mode and a higher altitude is selected, no mode reversion occurs.) However, if the FCU altitude change is illogical (e.g., if the aircraft is climbing and an altitude lower than the aircraft is selected), the V/S mode engages at the current rate of climb.

Changing the FCU altitude when in ALT* mode also causes a vertical reversion. These mode reversions are summarized in the table below.

Vertical Mode Engaged	FCU Altitude Selection Change	Vertical Mode Switches To
CLB OP CLB EXP CLB	Below Aircraft Altitude	V/S At Current V/S
DES OP DES EXP DES	Above Aircraft Altitude	V/S At Current V/S
ALT*	Any Change	V/S At Current V/S

Autothrust Mode Reversions

If the flight director is not followed when a fixed mode of thrust is active (THR CLB or THR IDLE) and VMAX is exceeded, the flight directors will disappear and the SPEED mode will become active. For example, if the pilot is hand flying in the OP CLB vertical mode, THR CLB is the active autothrust mode. If the pilot then begins to level off prior to reaching the target altitude (disregarding the flight directors), thrust will remain fixed at climb power and speed will accelerate until reaching V_{MAX}. Just above V_{MAX}, the flight directors will disappear and the autothrust will revert from a fixed thrust mode (THR CLB) to a variable thrust mode (SPEED or MACH). In SPEED or MACH, the thrust will be adjusted to maintain the target airspeed regardless of pitch.

Engaged Modes	Cause	Consequence
CLB OP CLB EXP CLB	Excessively Fast Speed (speed approaches V_{MAX}) (Pilot is holding pitch attitude below flight director pitch bar.)	V/S Mode engaged and autothrust SPD Mode engaged to regain target speed or V_{MAX}, whichever is lower.
DES OP DES EXP DES	Excessively Slow Speed (speed approaches V_{LS}) (Pilot is holding pitch attitude above flight director pitch bar.)	V/S Mode engaged and autothrust SPD Mode engaged to regain target speed or V_{LS}, whichever is greater.

Common Flight Guidance Modes

General

Common flight guidance modes include both lateral and vertical flight guidance modes. Some of these modes automatically engage when the appropriate conditions are met, such as the takeoff and go-around modes. Some modes require that a number of conditions be met before engaging. For example, the go-around mode does not engage unless the flap handle is selected to 1 or greater and TOGA thrust is selected when airborne.

Takeoff Mode

The takeoff flight guidance mode is automatically engaged when the thrust levers are advanced to takeoff thrust (or FLEX during a reduced thrust takeoff).

The takeoff flight guidance mode combines the Speed Reference System (SRS) vertical mode with the runway (RWY) lateral mode. The SRS and RWY modes are engaged simultaneously, but they may be disengaged separately.

Speed Reference System

The SRS mode provides the pilot with vertical flight guidance for optimum performance during normal takeoffs, following an engine failure at low altitudes, during a go-around, and during windshear.

This vertical mode provides pitch guidance with speed defined by the SRS. During takeoff, SRS commands:

- V_2 + 10 (both engines operating), or
- V_2 or current aircraft speed, if higher (one engine operating).

In both cases, SRS commands a minimum climb gradient of 120 ft/min and is limited to a maximum pitch angle of 18° during takeoff.

During a normal takeoff, the flight director pitch bar displays the pitch attitude for optimum climb performance. If an engine fails during takeoff, the flight director pitch bar must be followed to use SRS guidance for optimum single engine climb performance.

SRS automatically provides pitch guidance for optimum performance during go-around or a windshear recovery. SRS pitch limits during windshear are slightly higher than during takeoff.

The SRS speed target during a go-around is either the aircraft speed at go-around initiation, or V_{APP}, whichever is higher.

Common Flight Guidance Modes (continued)

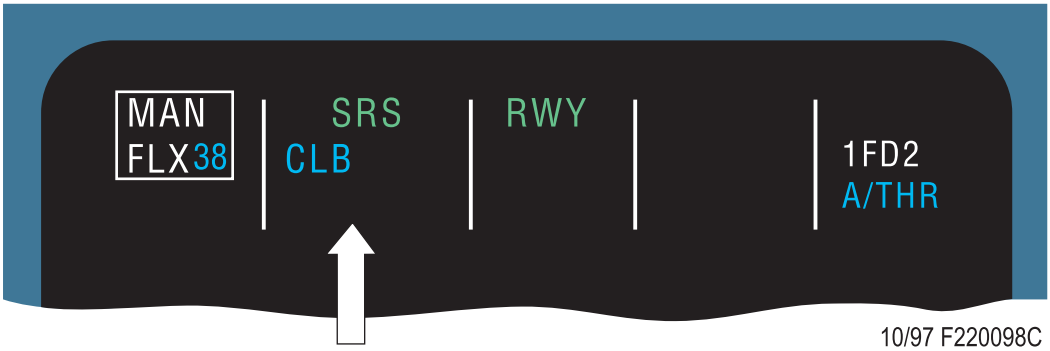
Speed Reference System (continued)

Engagement

SRS is automatically engaged during takeoff when the thrust levers are advanced to TOGA (or FLEX during a reduced thrust takeoff), provided that the aircraft has been prepared for a normal takeoff. This requires that:

- V_2 is inserted on the MCDU performance takeoff page (refer to chapter 34, Navigation: MCDU Operations), and
- the flap handle is selected to 1 or greater.

An example FMA showing SRS engaged during the takeoff roll is shown below.



The SRS mode is also automatically engaged during a go-around when the thrust levers are advanced to TOGA.

Note: If V_2 is not inserted, SRS will not engage at takeoff initiation. Five seconds after liftoff, V/S mode will engage. Upon engagement of V/S mode, the current airspeed will become the FCU target airspeed. To regain normal speed, either select an appropriate speed on the FCU and PULL or, PUSH the A/THR pb on the FCU (because A/THR will not be armed), set the thrust levers to the climb detent and select Managed Speed.

Disengagement

SRS is automatically disengaged when the aircraft reaches the acceleration altitude (normally 1,000 feet AGL, refer to Chapter 34.30, MCDU Operations). SRS does not disengage in any case until above 400 feet AGL.

SRS can be manually disengaged by V/S (FPA) or any climb mode (CLB, OP CLB, or EXP CLB). For example, if an engine fails after takeoff, the pilot levels off at 1,000 feet by selecting V/S to zero. This disengages the SRS mode.

SRS mode does not disengage if the FCU altitude is below the current aircraft altitude. For example, SRS does not automatically disengage if the pilot forgets to set the FCU altitude before takeoff (leaving it set to field elevation). If the pilot moves the FCU altitude below the current altitude with SRS engaged, it does not disengage.

Common Flight Guidance Modes (continued)

RWY Mode

The runway (RWY) mode provides lateral guidance during the takeoff roll and during the initial climb only when a localizer signal is available. This mode is automatically replaced by runway track (RWY TRK) mode or NAV mode, if armed, shortly after takeoff.

Note: The localizer, if available, is automatically tuned when the departure runway is selected on the MCDU flight plan page (refer to 34.30, MCDU Operations).

Engagement

The RWY mode engagement conditions are the same as the SRS mode, plus a localizer signal must be received with deviation within limits.

Disengagement

The RWY mode disengages automatically:

- if the localizer signal is lost, or
- at 30 feet AGL after takeoff (it is replaced by NAV mode, if armed, or by RWY TRK mode if a heading was preselected).

RWY TRK Mode

The RWY TRK mode provides lateral guidance to the extended runway centerline shortly after takeoff. The mode automatically engages if NAV mode does not engage (NAV not armed prior to takeoff). For example, the RWY TRK mode engages if a heading was preset prior to takeoff.

Note: The RWY TRK mode does not require a localizer signal.

The RWY TRK mode disengages when another lateral mode is engaged. For example, when departing on parallel runways, if the clearance is to maintain runway heading, the HDG mode must be engaged shortly after lift off. HDG mode prevents an aircraft flying a runway track converging with an aircraft on a parallel runway which is flying runway heading.

Common Flight Guidance Modes (continued)

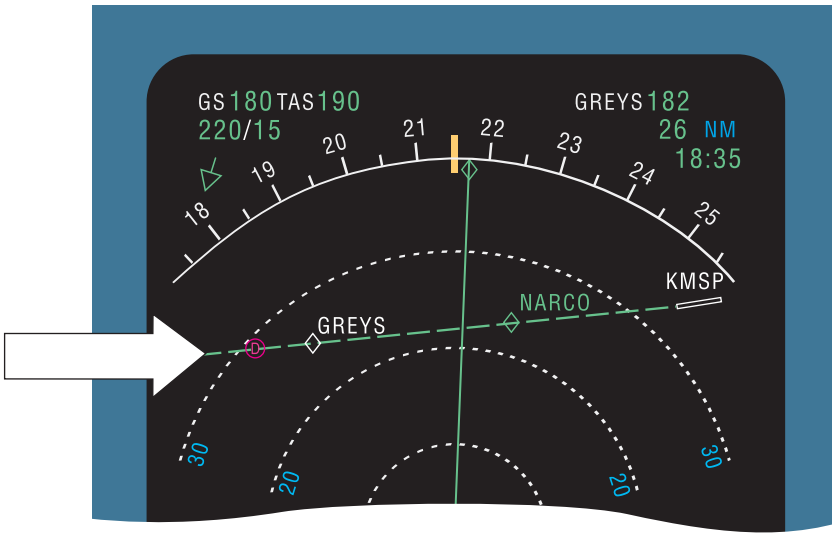
Approach Mode

Flight guidance is provided for three different types of approaches:

- ILS approaches (this includes LOC only and LDA approaches),
- non-ILS approaches (VOR, NDB, or RNAV), or
- visual approaches.

DECEL Point

A computed approach deceleration (DECEL) point is displayed on the ND and MCDU (refer to 34.30, MCDU Operations). The deceleration point is depicted as a magenta circled “D.”



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If the aircraft is in managed lateral NAV, LOC* or LOC mode and overflies the deceleration point:

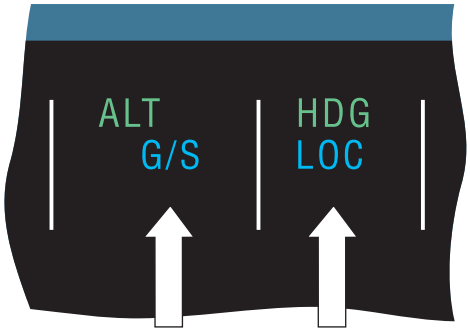
- the FMS approach phase is activated, and
- the managed target speed decreases from the descent phase ECON speed (usually 250 knots below 10,000 feet) to maneuvering speed at this point. The speed corresponds to the selected flap setting (e.g., green dot, S, F, or V_{APP}) as previously described.

Common Flight Guidance Modes (continued)

ILS Approach

An ILS approach is flown by coupling the flight directors (and/or the autopilot) to the ILS localizer and glide slope signals. Coupling is accomplished by pressing the FCU APPR pb after an ILS frequency has been tuned (refer to ch. 34, Navigation). If only the localizer is to be tracked, the FCU LOC pb is used (refer to LOC lateral mode, previously discussed). An LDA approach (with glideslope) also uses these modes.

With an ILS approach selected in the flight plan (or an ILS frequency is manually tuned on the RMP), pushing the APPR pb arms the LOC and G/S modes. When armed, these modes engage without further FCU actions when the required conditions are met.



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In the example above, the heading may be modified prior to LOC* mode by turning the FCU HDG knob (without pulling). However, if the HDG knob is pulled, the LOC mode is disarmed.

Note: If the FCU APPR pb is pushed above approximately 5,000 feet AGL (depending on the type of radar altimeter installed), a CAT 1 FMA annunciation may be displayed in column 4. When the radar altimeters become valid the indication will upgrade to CAT 3.

The approach mode can be disarmed prior to LAND mode being displayed on the FMA by:

- depressing the illuminated APPR pb (this disarms the LOC and G/S modes and results in HDG - V/S modes),
- depressing the LOC pb (this disarms the G/S mode and results in V/S mode), or
- selecting any other lateral mode (resulting in NAV or HDG mode, plus V/S).

The APPR pb will not arm if the LAND mode is not functional. For example, if both glide slope receivers are inoperative, the APPR pb will not arm.

Note: The G/S mode is not available if a database non-precision approach (VOR, NDB, or RNAV) is in the flight plan. In this case, the APPR pb selects the FINAL mode.

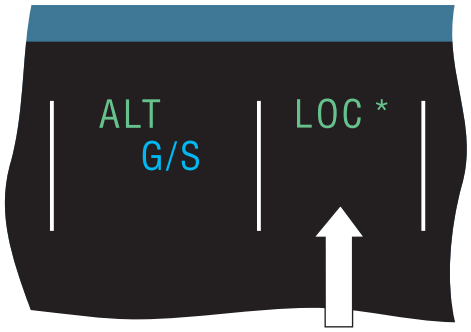
Common Flight Guidance Modes (continued)

ILS Approach (continued)

Lateral Guidance During ILS Approach

The lateral flight guidance remains in the previously engaged mode until localizer interception begins. HDG mode remains engaged and the heading may be modified until localizer capture begins.

The pilot can recognize that localizer capture has begun by noting LOC* on the FMA.



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If the aircraft is on a heading (or track) en route to the localizer, the green ND flight plan line is dashed. In both the LOC and NAV modes, the flight plan line on the ND is solid green when the mode engages. Therefore, the FMA must be referenced to verify the engaged lateral mode.

Vertical Guidance During ILS Approach

The glide slope (G/S) mode is armed only with the FCU APPR pb. The FCU altitude can be modified with the G/S mode armed. FCU altitude changes function in the normal manner until G/S capture.

The G/S mode can engage before LOC* mode engages. This results in the aircraft descending on the glide slope and the FCU altitude is ignored. In this case, the G/S mode can be disarmed by using the FCU LOC pb or engaging a selected vertical mode if required by ATC to maintain altitude until established on the localizer course.

Note: The autoflight system will not initiate a glide slope capture from above. If above the G/S, the pilot must use a vertical mode (e.g. V/S) to intercept the glide slope. However, excessive V/S may result in airspeed exceeding Vmax for the aircraft configuration. If the airspeed Vmax, the V/S will automatically be adjusted to maintain Vmax.

Caution: *The FCU APPR pb should not be pushed until the aircraft is on an inbound intercept heading for the approach. The autoflight system has the capability to track outbound and climb on the glide slope signal.*

Caution: *The maximum rate of descent for capturing the G/S is approximate 2,500 ft/min.*

After G/S capture, FCU altitude changes are ignored (without pulling or pushing the ALT knob). This allows the missed approach altitude to be preset.

Engaging another vertical mode after G/S capture (e.g., V/S) disarms the G/S mode.

Common Flight Guidance Modes (continued)

Approach Capabilities

During an ILS approach, the aircraft approach capabilities are displayed on the FMA when the APPR pb is illuminated. The autoflight system is self monitoring and the aircraft's current approach capabilities are annunciated as either CAT I, II, or III, depending on the status of aircraft systems.

10/97 F220102C

The approach capabilities annunciation does not relate to the status of any ground signal. For example, the loss of the ILS localizer transmitter does not change the approach capabilities annunciation.

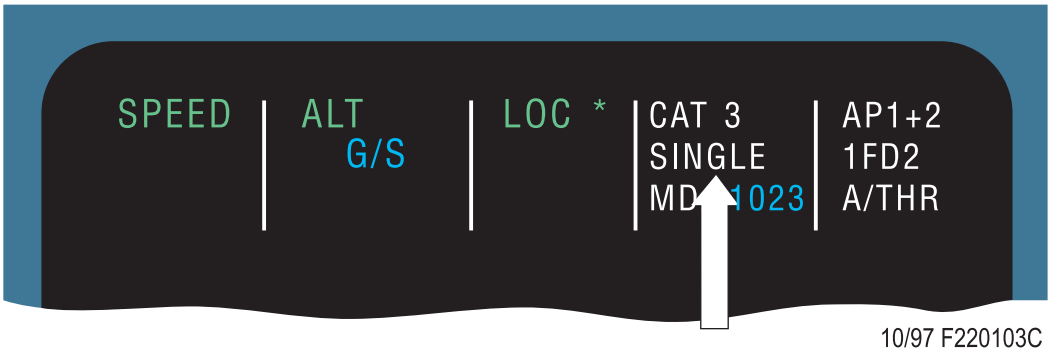
Note: Refer to Vol.1, L.10 for approach capabilities requirements for performing a specific approach.

Note: Certain unmonitored systems may be required for performing a specific approach (for example, the standby attitude indicator). The appropriate checklist must be used in addition to the FMA indication.

In addition to the category annunciation, a SINGLE or DUAL annunciation is displayed on line 2.

SINGLE

This annunciation indicates that the autoflight system is in a fail passive condition. One or more systems has lost redundancy (e.g., one yaw damper is inoperative).



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Common Flight Guidance Modes (continued)

Approach Capabilities (continued)

DUAL

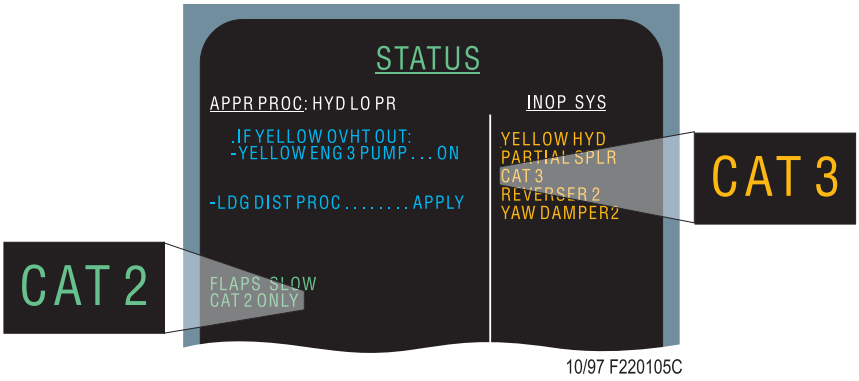
This annunciation indicates that the autoflight system is in a fail operational condition. All monitored systems have redundant capabilities.

10/97 F220104C

Note: Both autopilots must be engaged for DUAL to be annunciated. However, the autopilots are only one of many systems which must be redundant for DUAL to be annunciated.

Aircraft Status

The approach capabilities can be determined prior to arming the APPR pb by referencing the ECAM STATUS page. If CAT III dual is not possible, it will be displayed as inoperative. In the example below, CAT III is inoperative. The approach procedure area of the page shows that the aircraft capabilities are reduced to CAT II.



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Common Flight Guidance Modes (continued)

Autoland

An autolanding can be performed only from an ILS approach. Once the FCU APPR pb has been armed the second autopilot can be engaged. Once engaged, the autopilots complete the approach, flare, landing, and continue to guide the aircraft through the completion of the roll-out.

During the flare, the autothrust system retards the thrust to idle, and an aural “RETARD” call is provided at 10 feet AGL. The pilot must manually select reverse thrust after touchdown. The pilot can confirm that the aircraft capabilities are adequate for performing an autolanding by:

- checking the ECAM STATUS page (refer to chapter 31, Flight Instruments), or
- checking the FMA approach capabilities after arming the FCU APPR pb.

A CAT III SINGLE or DUAL indication is required for an autolanding.

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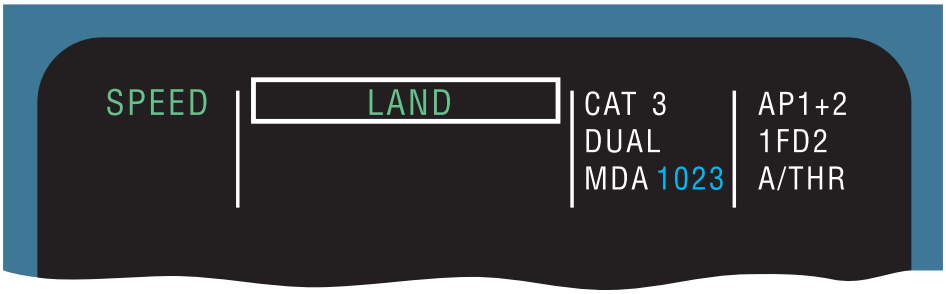
LAND Mode

An autolanding uses the LAND, FLARE, and ROLLOUT modes. The LAND mode automatically engages at 400 feet AGL when both the LOC and G/S modes are engaged. The mode is annunciated on the FMA.



10/97 F220107C

The LAND mode requires many aircraft systems to function properly. It does not engage, or remain engaged, if the required systems are inoperative.

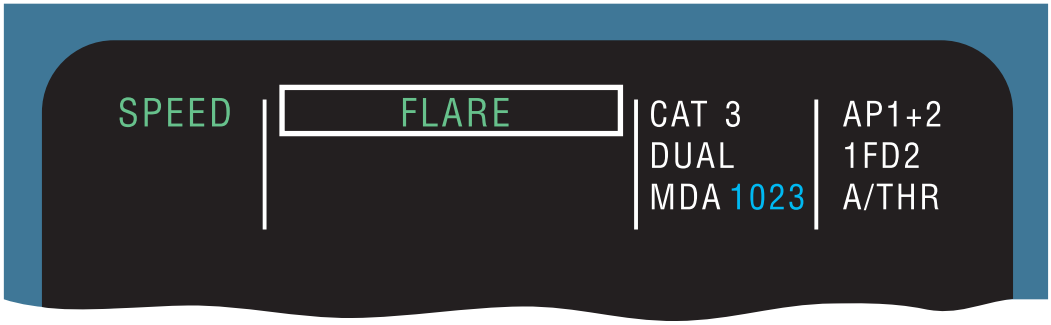
To disengage the LAND mode, a go-around must be performed or the autopilots must be disconnected. No FCU actions disengage LAND mode.

LAND mode is automatically replaced by the FLARE mode at approximately 40-50 feet AGL (depending on the descent rate).

Common Flight Guidance Modes (continued)

FLARE Mode

The FLARE mode automatically engages at approximately 40-50 feet AGL (depending on descent rate) during autolandings. The mode is annunciated on the FMA. To disengage the FLARE mode, a go-around must be performed or the autopilots must be disconnected.



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Warning

The lack of a FLARE annunciation during an autolanding requires immediate pilot action. (A go-around during a CAT II or III approach, or a manual landing if weather and Vol. 1 restrictions permit).

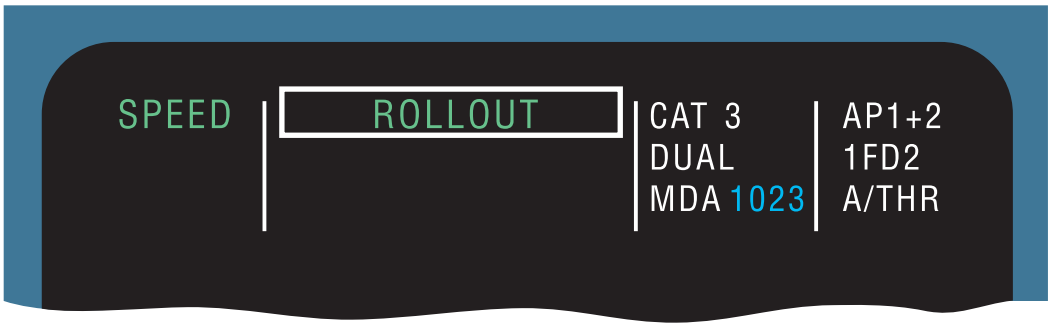
Crosswind Corrections

To compensate for crosswinds, the autoflight system will fly the ILS approach in a wings level crab until the flare. If crosswinds are present when the FLARE mode engages, the aircraft's heading is aligned with the runway and the touchdown is accomplished with a wing low.

Common Flight Guidance Modes (continued)

ROLLOUT Mode

The ROLLOUT mode automatically engages after touchdown during autolandings. The autopilots remain engaged and track the runway centerline utilizing the localizer signal and nosewheel steering. The autobrake system brings the aircraft to a stop.

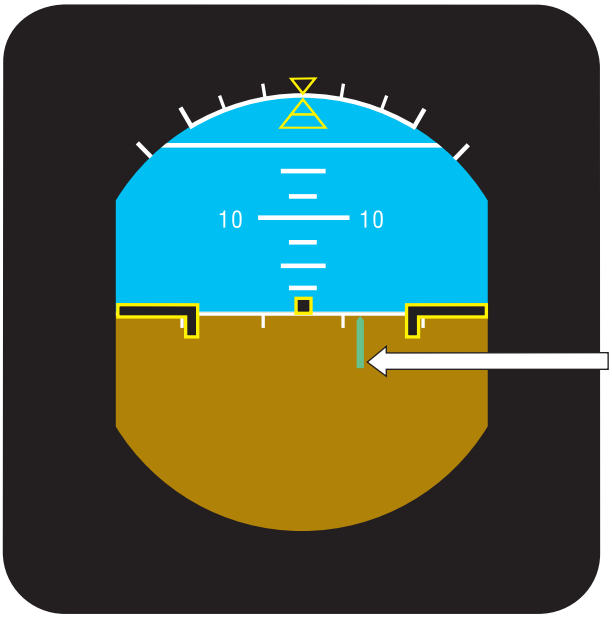


10/97 F220109C

Note: Pilot rudder inputs during landing rollout will cause the autopilots to disengage. If a steering correction is required, the autopilots should be disconnected and steering controlled manually.

Note: The pilot must manually disengage the autopilots before turning off the runway centerline, as the ROLLOUT mode tracks the runway centerline.

The ground roll guidance command bar is displayed on the PFD in the ROLLOUT mode as shown below.



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Common Flight Guidance Modes (continued)

Autoland and Flight Guidance Warnings

Excessive Deviation Warnings

After the localizer and glide slope have been captured, the localizer scales flash if the aircraft position exceeds 1/4 dot deviation. The glide slope scales flash if the deviation exceeds one dot.

Landing Capability Downgrade Warning

A triple click aural warning (cricket) is generated in the event of a landing capability downgrade. For example, the loss of one yaw damper would downgrade landing capabilities from CAT III DUAL to CAT III SINGLE.

This warning is inhibited below 100 feet AGL.

Loss of ILS Signal Warnings

Loss of the localizer and/or glide slope signal results in the following:

- the corresponding index is removed from the localizer or glide slope scale,
- the corresponding scale flashes, and
- the corresponding flight director bar flashes.

Loss of the ILS Receiver Warnings

If a single localizer and/or glide slope receiver fails:

- a red flag is displayed on the PFD and ND as appropriate, and
- the flight director roll and/or pitch bar automatically receives guidance from the remaining receiver.

If both localizer and/or glide slope receivers fail:

- the flight guidance modes revert to HDG and V/S (or TRK/FPA), and
- LOC and G/S scales are removed from the PFDs and NDs, and are replaced with red flags.

In addition, if an autopilot were engaged and the LOC and/or G/S mode were engaged, the autopilot will automatically disengage.

Common Flight Guidance Modes (continued)

Autoland and Flight Guidance Warnings (continued)

Autoland Warning Light

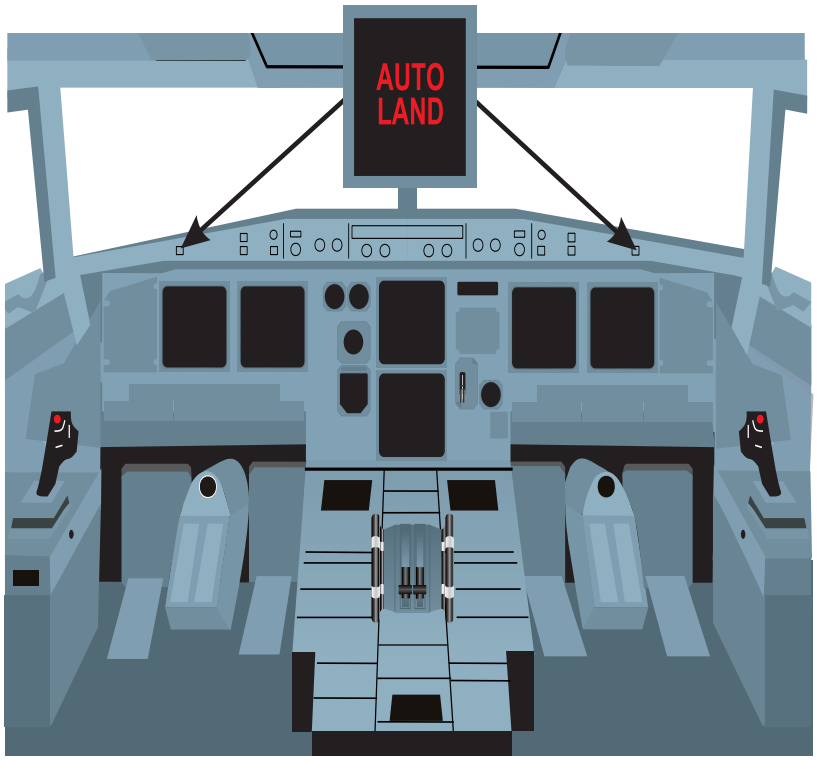
Two glareshield AUTOLAND warning lights illuminate during certain critical failures during an autolanding.

The autoland warning light will illuminate below 200 feet during an autolanding if any of the following occur:

- both autopilots fail,
- an ILS ground transmitter fails (loss of localizer or glide slope ground signals),
- a significant difference between radar altimeters is detected,
- both aircraft ILS receivers fail, or
- excessive ILS deviation (the autopilots are not following the localizer or glide slope accurately).

Note: If the warning was a result of a dual autopilot failure, it is necessary to manually complete the landing or go-around.

The autolanding warning lights are shown below.



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Note: If the failure was a result of a dual autopilot failure, the master warning lights will also illuminate and the aural CRC occurs.

Common Flight Guidance Modes (continued)

Non-Precision Approach (LOC Strategy)

Vertical flight guidance for non-precision approaches is manually controlled by the pilot. A vertical mode is used to capture selected FCU altitudes, and descend to the MDA.

For lateral navigation, the pilot couples the flight guidance to the front course localizer signal by using the LOC mode (localizer only and LDA without glideslope approaches).

Non-Precision Approach (APPR NAV)

FMS approach guidance is provided for RNAV, VOR, or NDB non-precision approaches entered in the MCDU flight plan. Guidance is provided down to the MDA.

APP NAV mode provides lateral guidance and FINAL provides vertical guidance.

The FMS uses the data for the approach stored in the database for the approach. External navigation signals are not tracked. An expanded vertical path indication labeled VDEV is displayed to allow monitoring of the vertical flight path.

Pushing the APPR pb arms APP NAV. If managed NAV was armed, then APP NAV engages immediately. APP NAV tracks the flight plan legs in exactly the same manner as managed NAV. If managed NAV was not armed, APP NAV arms and captures the flight plan leg upon interception.

FINAL provides the vertical guidance to the DA or MDA.

Arming

APP NAV and FINAL are armed by pushing the APPR pb if the following conditions are met:

- The aircraft is above 400 ft. RA
- The lateral and vertical flight plan is valid
- The active flight plan has a non-precision approach selected
- Go around mode is not engaged

Common Flight Guidance Modes (continued)

Non-Precision Approaches (APPR NAV) (continued)

When armed, the FMA annunciates FINAL and APP NAV in blue. If managed NAV was armed, then APP NAV engages immediately (as seen below).

E220090a

Engagement

FINAL and APP NAV both engage under the same conditions. If managed NAV was engaged, APP NAV engages immediately. If HDG (TRK) was engaged, APP NAV engages when the intercept conditions are met (i.e., the aircraft track must intercept the flight plan active leg).

FINAL engages if all of the following conditions are met:

- Approach phase is active and the DECEL point has been overflown.
- APP NAV is engaged and cross track error is less than 1.5 NM
- The aircraft intercepts the vertical path either:
  - In ALT or ALT* as it intercepts a descending leg of the profile, or
  - In V/S, FPA, DES or OP DES as it intercepts a level segment of the vertical profile, if the FCU altitude is different than the level off segment altitude

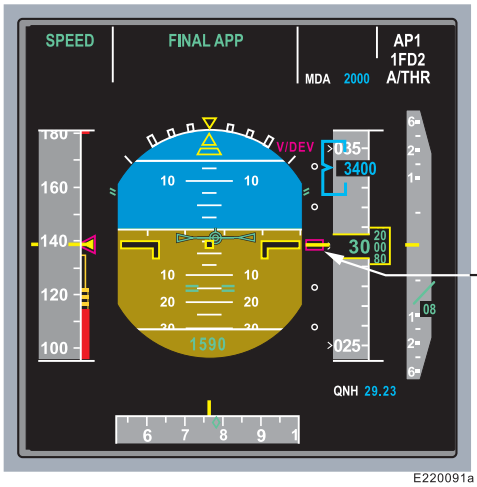
Indications

Note: If GPS PRIMARY is lost during the approach, a triple click aural warning sounds.

On the PFD, the VDEV indication shows the relationship to the vertical path. The display range of the VDEV indicator is +/- 200 ft. The indicator remains at full deflection if the deviation from the path exceeds 200 feet.

Common Flight Guidance Modes (continued)

Non-Precision Approaches (APPR NAV) (continued)



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E220092a

Disarming

FINAL and APP NAV are disarmed by:

- pushing the APPR pb a second time,
- pushing the LOC pb (LOC arms), or
- engaging the go-around mode.

Common Flight Guidance Modes (continued)

Non-Precision Approaches (APPR NAV) (continued)

Disengagement

FINAL and APP NAV disengage if:

- The MDA -50 ft. is reached (or 400 ft. RA if no MDA or MDH was inserted). HDG V/S or TRK FPA engages.
- Go-around mode is engaged.
- The APPR pb is pushed (HDG V/S or TRK FPA engages).
- The LOC pb is pushed:
  - if an ILS is tuned, LOC engages, or
  - if an ILS is not tuned, HDG V/S or TRK FPA engages.
- The HDG knob is pulled.
- The V/S - FPA knob is pulled.
- The altitude selection knob is pulled.

GO-AROUND Mode

The FMS GO-AROUND (GA) mode automatically engages when airborne and GA thrust is selected with the flap lever at 1 or greater. During go-around, flight director guidance will either remain active or be restored. If both autopilots were used during the approach, AP 2 automatically disengages (without a warning) during the go-around.

Note: Selection of TOGA thrust during a go-around, even momentarily, is important in that it engages the FMS go-around phase. Selection of TOGA:

- automatically re-enters the selected approach into the flight plan, prevents the FMS from erasing the destination airport if overflown,
- engages the SRS vertical mode, which commands the appropriate airspeed for initial climb out and acceleration,
- automatically arms the autothrust if it was off,
- restores the flight directors in the normal crossbar display if the flight directors are off when the go-around is initiated,
- reverts the flight directors to the normal crossbar display if operating in the Track/Flight Path Angle (TRK/FPA) when the go-around is initiated.

Lateral Guidance

Lateral guidance is provided to the flight directors during a go-around. If a go-around is initiated (TOGA thrust selected when the slats/flaps are extended), NAV mode will stay engaged or NAV mode will automatically arm, as follows:

- If the aircraft was previously in NAV, APP NAV or FINAL APP mode, then the flight guidance keeps NAV mode engaged, or it automatically reverts to NAV.
- If the aircraft was previously in HDG/TRK mode, then the flight guidance will keep HDG/TRK mode engaged, however, NAV mode is automatically armed.
- If the aircraft was previously in ILS mode (LOC, LOC*), then GA TRK mode is engaged, however, NAV mode is automatically armed. In this case the crew may still preselect a desired go-around HDG once LOC is captured. If a heading is not preselected, NAV will automatically arm when the go-around is initiated.

Common Flight Guidance Modes (continued)

GO-AROUND Mode (continued)

Vertical Guidance

When the GA mode engages, the vertical guidance mode is SRS. This mode is similar to SRS during takeoff except that the target speed is the current aircraft speed at go-around mode engagement, or V_{APP}, whichever is higher. CLB mode is automatically armed and engages at the go-around acceleration altitude (normally 1,000 feet AGL, refer to ch. 34, Navigation). The SRS mode is disengaged when any other vertical mode engages.

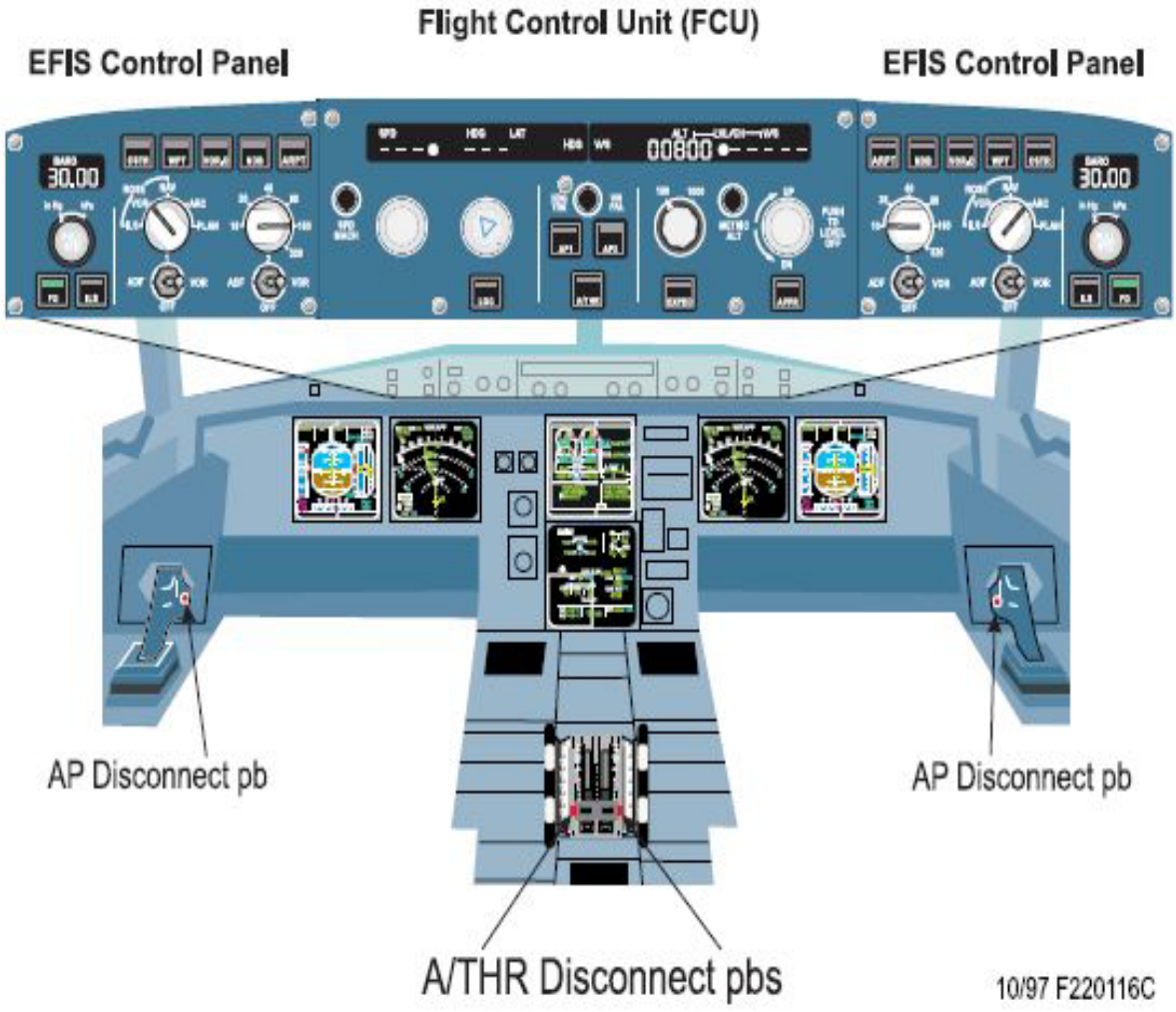
Caution: *Altitude constraints in the vertical flight plan are ignored when the GA mode is engaged. Only the FCU altitude is honored in this phase of flight.*

Controls and Indicators

Location of Controls and Indicators

Introduction

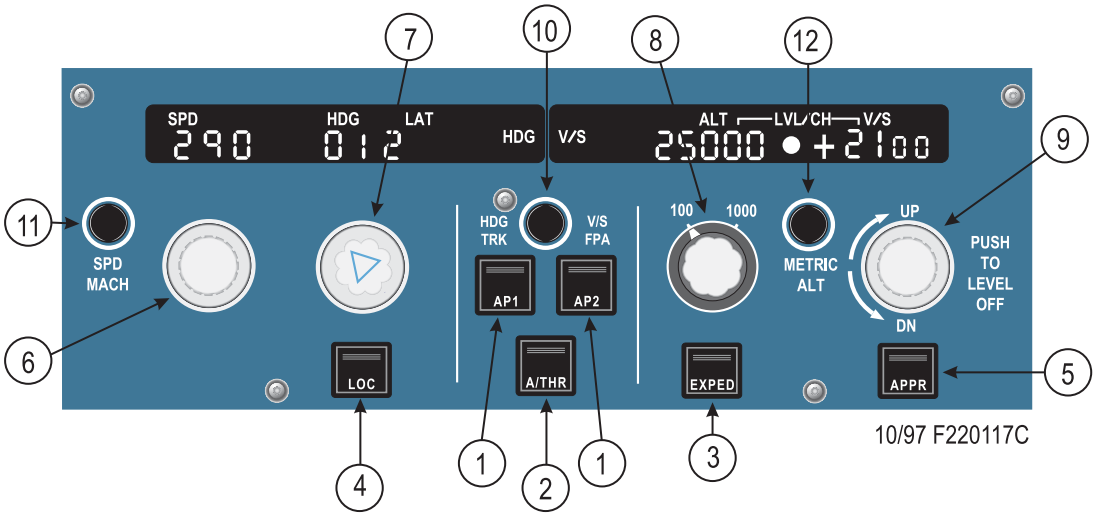
Controls and indicators associated with the autoflight system are located throughout the front of the cockpit.



Flight Control Unit

General

The Flight Control Unit (FCU) is centrally located on the glareshield.



1 AP pbs

The AP pbs on the FCU are used to engage and disengage the autopilots. An illuminated AP pb indicates that the corresponding autopilot is engaged. Depressing an illuminated AP pb disengages the autopilot.

2 A/THR pb

The A/THR pb on the FCU is used to arm the autothrust system. An illuminated FCU pb indicates that the autothrust system is armed or active. Depressing an illuminated A/THR pb selects the autothrust system to off.

3 EXPED pb

The EXPED pb is used to engage the expedite modes (either EXP CLB or EXP DES). An illuminated EXPED pb indicates that an EXP mode is engaged. Depressing an illuminated EXPED pb has no effect.

4 LOC pb

The LOC pb is used to arm the LOC mode. This couples the flight guidance system to the localizer front course signal after capture. An illuminated LOC pb indicates that the LOC mode is armed. Depressing an illuminated LOC pb disengages the LOC mode. If the APPR pb is depressed when the LOC pb is illuminated, the LOC mode remains engaged but the LOC pb is no longer illuminated.

Flight Control Unit (continued)

5 APPR pb

The APPR pb arms the flight guidance to capture the final approach guidance. The final approach guidance can be either an ILS or non-ILS approach. During an ILS approach, the APPR pb is used to arm the G/S and LOC modes. This couples the flight guidance to the ILS localizer and glide slope signals after capture. During a data base VOR, RNAV, or NDB approach, the APPR pb arms the FINAL and APP NAV modes.

Depressing an illuminated APPR pb disengages the final approach guidance, resulting in a flight guidance reversion to the V/S and HDG modes. However, the APPR pb cannot be used to disengage ILS guidance when the LAND mode is engaged.

6 SPD/MACH Knob

The SPD/MACH knob is used to selected a desired speed or Mach, or to activate managed speed.

When pulled, SPD/MACH is controlled by the pilots. The selected SPD/MACH is displayed in the FCU window and the speed triangle on the airspeed indicator is blue. Turning the knob sets the desired SPD/MACH. When pushed, SPD/MACH is managed. In managed SPD/MACH, the FCU window is dashed, the managed guidance white light is illuminated, and the speed triangle on the airspeed indicator is magenta.

7 HDG/TRK Knob

The HDG/TRK knob is used to select a desired heading (or track), or to activate managed NAV.

When pulled, the current aircraft heading (or track) is displayed in the window. Turning the knob sets the desired heading (or track).

Note: Pulling the HDG/TRK knob will cause CLB (or DES) vertical mode (if engaged). To revert to OP CLB (or V/S) (refer to 22.10, Vertical Modes).

When pushed:

- managed FMS navigation is armed,
- the managed guidance white light illuminates, and
- the lateral navigation guidance is to the FMS flight plan. The FCU window will be dashed once the flight plan is intercepted and the NAV mode engages (refer to 34.31, MCDU Operations).

Flight Control Unit (continued)

8 Altitude Selection Knob

The altitude selection knob is used to select the altitude and to engage the vertical modes. Turning the knob increases or decreases the altitude in the window. The outer ring of the knob allows the pilot to select altitude increments of either 100 feet or 1,000 feet.

An altitude can be preset at any time by turning the knob without pulling or pushing. No change in altitude occurs until the knob is pushed or pulled (unless a climb or descent is already in progress). The FCU altitude window is never dashed.

When pulled, the OP CLB or OP DES mode is engaged.

When pushed, the CLB or DES mode is engaged (managed climb or descent) and the managed guidance light illuminates. Managed NAV mode is required for CLB or DES modes.

Note: The altitude may inadvertently change when the knob is pushed or pulled.

9 V/S or FPA Knob

The V/S (FPA) knob is used to selected a desired vertical speed (V/S) or flight path angle (FPA).

When pulled, the current aircraft vertical speed (or FPA) is engaged and the value displayed in the window. Turning the knob selects the desired V/S (or FPA). A desired V/S (or FPA) can be preset by turning the knob and then pulling it. However the knob must be pulled within a few seconds or the preset V/S (or FPA) is erased.

Pushing the knob initiates a level off, and has the same effect as selecting the V/S (FPA) to zero. The FMA mode is ALT.

10 HDG V/S TRK FPA pb

This pb changes the lateral mode reference from HDG to TRK and the vertical mode from V/S to FPA. Subsequent depressions return the modes to the previous selections. The flight director displays change from pitch and roll command bars to the FPV symbol and a single command bar when the modes change from HDG V/S to TRK FPA.

Flight Control Unit (continued)

(11) Speed/Mach pb

This pb changes the speed reference window from knots to Mach. A subsequent depression returns the speed reference to knots. The speed/Mach reference automatically switches in accordance with a predetermined schedule during climbs or descents.

(12) METRIC ALT pb

This pb displays the selected FCU altitude in meters on the ECAM systems display (SD) page when selected (refer to ch. 31, Flight Instruments). A second depression clears this altitude indication from the SD.

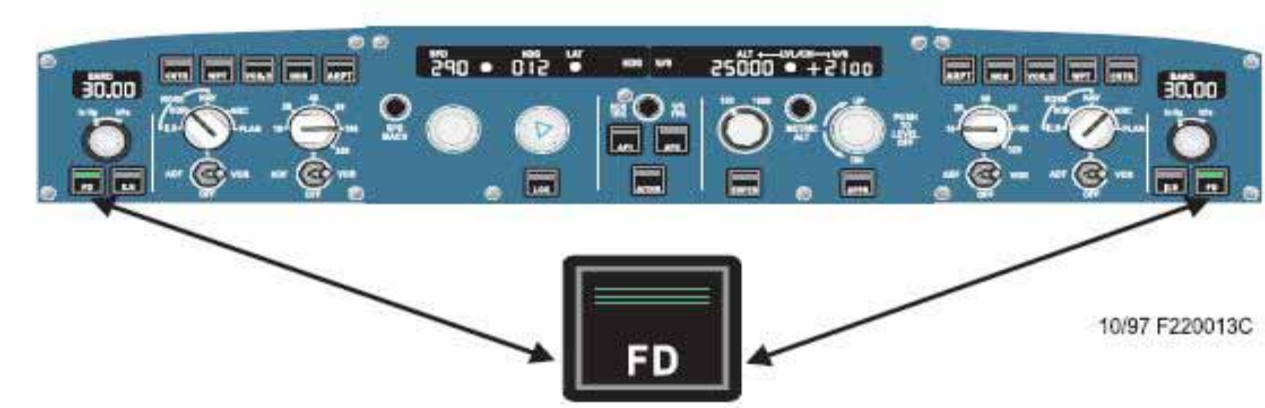
Flight Director pbs

Function

The Flight Director (FD) pbs are used to engage the flight directors. Each pb engages the flight director on that side of the aircraft only.

Depressing an illuminated FD pb disengages that flight director. The FD pbs are shown below

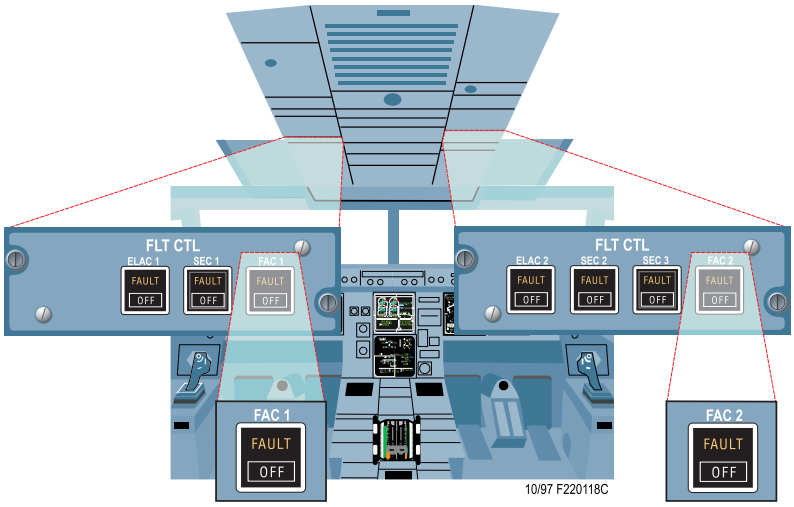
.



Flight Augmentation Computer pbs

Function

The Flight Augmentation Computer (FAC) pbs are located on the cockpit overhead panel and are used to reset the FACs. The normal condition is lights out. The FAC pbs are shown below.



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OFF

The following actions occur when a FAC pb is selected OFF (operational FAC):

- the OFF light illuminates, and

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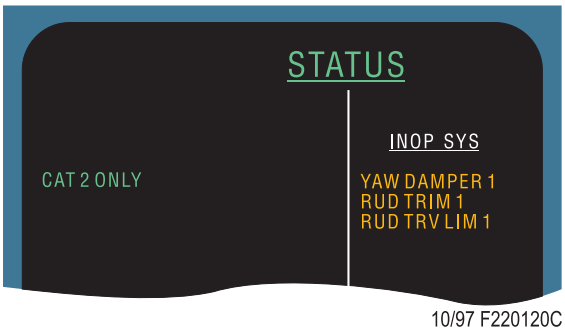
- all rudder functions controlled by that FAC are disabled.



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Note: If an operational FAC is selected OFF, it continues to compute flight envelope information for PFD display.

Flight Augmentation Computer pbs (continued)

FAULT Light

An amber FAULT light indicates that all functions associated with that FAC are inoperative until reset. This may have been caused by an electrical power interruption.

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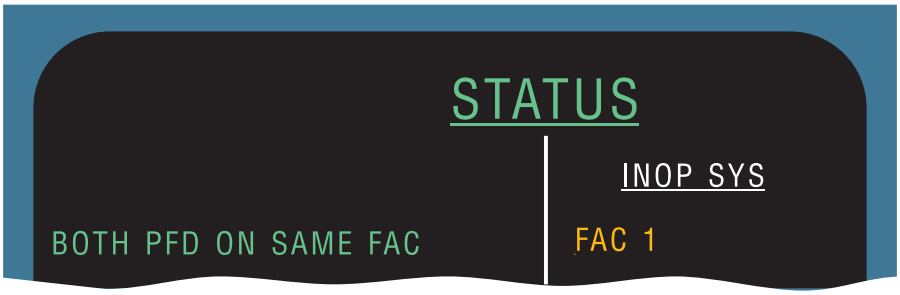
When the fault light illuminates:

- the opposite FAC automatically computes the flight envelope, and
- an ECAM message is displayed.



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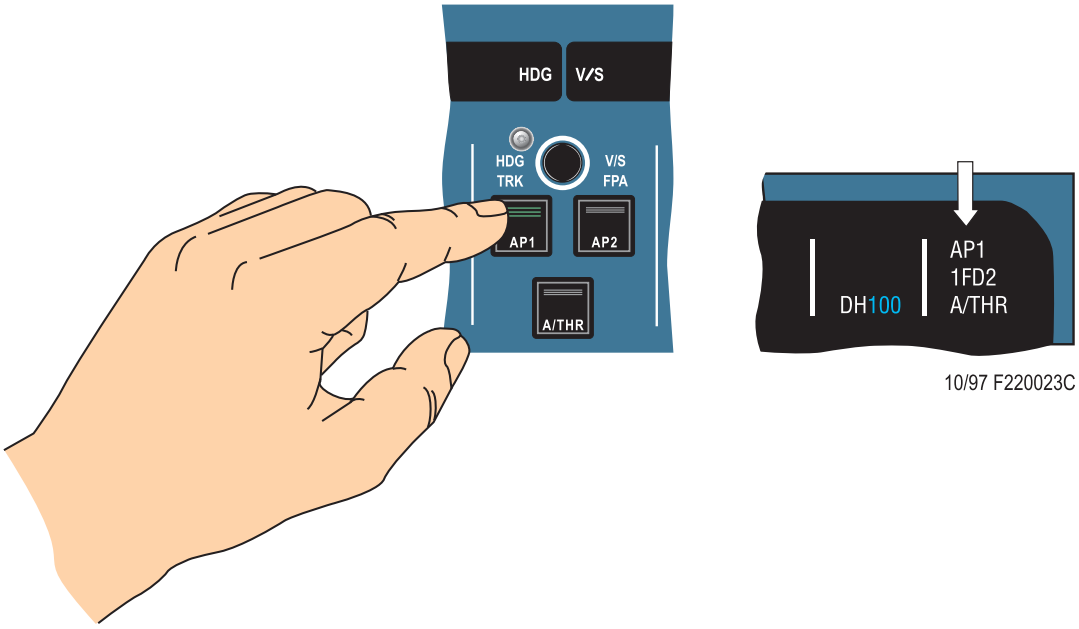
Autopilot Indications

Engaged Indications

An illuminated FCU AP pb indicates that the associated autopilot is engaged. An FMA annunciation also indicates that the associated autopilot is engaged.



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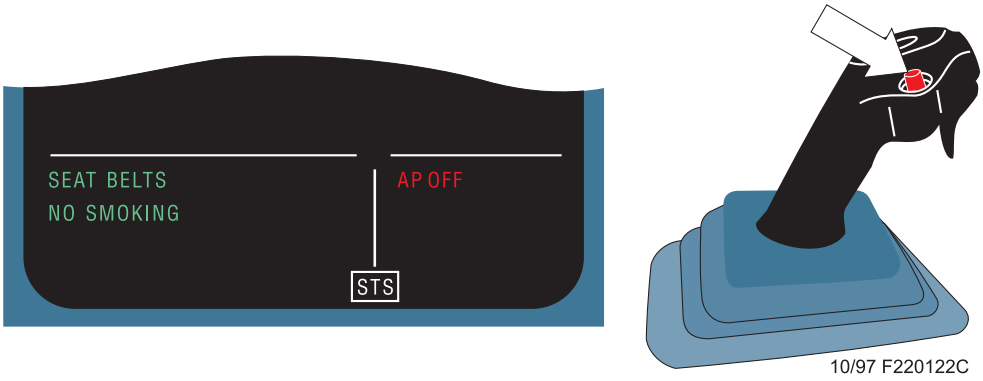
Disengagement Indications

Normal

A normal autopilot disengagement (using the side stick autopilot disconnect pb) is indicated by:

- a momentary MASTER WARN light,
- a momentary AP OFF message on the right side of the E/WD, and
- a momentary aural cavalry charge.



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Note: A second depression of the autopilot disconnect stops the cavalry charge immediately and erases the E/WD message.

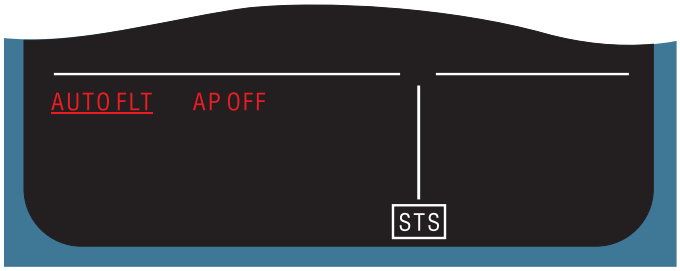
Autopilot Indications (continued)

Disengagement Indications (continued)

Alternate Disengagements and Failure

A failure of the autopilot, or an alternate disengagement, is indicated by:

- a red MASTER WARN light,
- a red AP OFF message on the left side of the E/WD, and
- an aural Continuous Repetitive Chime (CRC) (refer to chapter 31, Flight Instruments).



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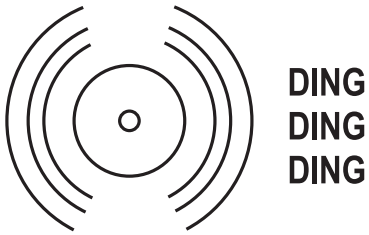

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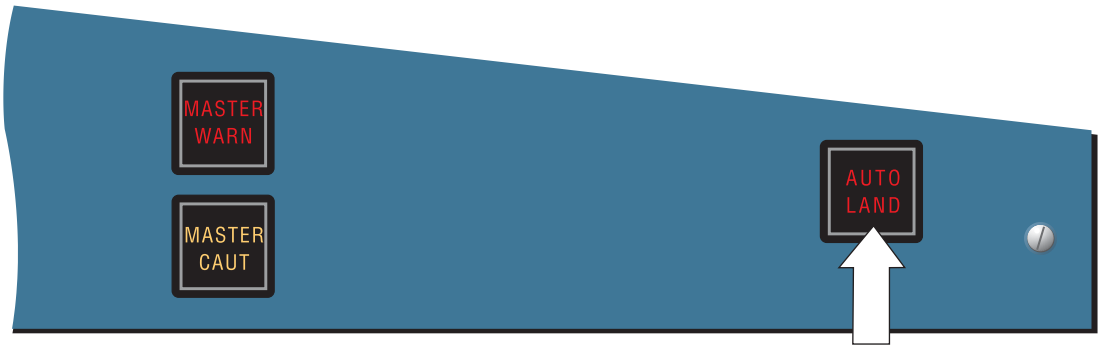
Depressing the MASTER WARN light or an autopilot disconnect pb silences the CRC and extinguishes the MASTER WARN light. The E/WD message must be cleared manually (refer to ch. 31, Flight Instruments).

Autoland Warnings

The autoland warnings occur if one or more of the following conditions occur at low altitude with the LAND mode engaged:

- both autopilots fail,
- loss of ILS LOC or G/S ground signal, or
- excessive ILS beam deviation.



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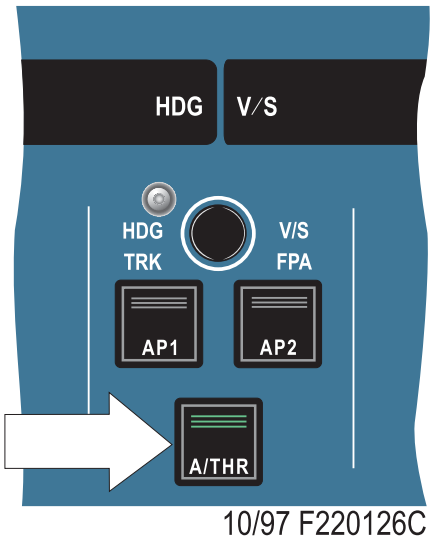
Note: If the failure was a result of a dual autopilot failure, the master warning lights illuminate and the aural CRC occurs.

Autothrust Indications

Autothrust Indications

An illuminated FCU A/THR pb indicates that autothrust is armed or active.



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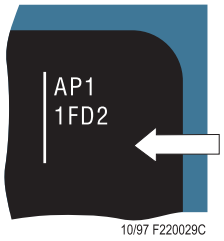
Autothrust FMA annunciations in column 5 are as follows.

If blank, autothrust is off (i.e., manual thrust).



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If blue,

autothrust is armed (thrust levers outside active range)

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Whenever autothrust is armed, but the pilot is controlling the thrust with the thrust levers, a white box is displayed along with a MAN annunciation.

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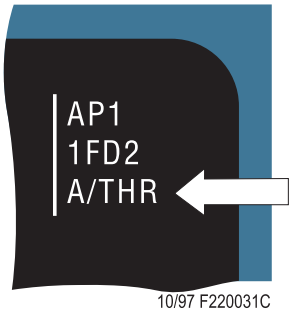
If white, autothrust is active and is controlling thrust.



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Autothrust Indications (continued)

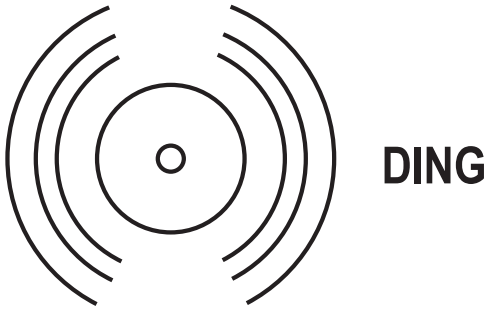
Autothrust Disconnect Indications

Normal

A normal autothrust disconnect, using either thrust lever disconnect pb, is indicated by:

- a momentary amber MASTER CAUT light,
- a momentary amber A/THR OFF message on the right side of the E/WD, and
- a single audio chime.

Thrust immediately changes to match the position of the thrust levers.



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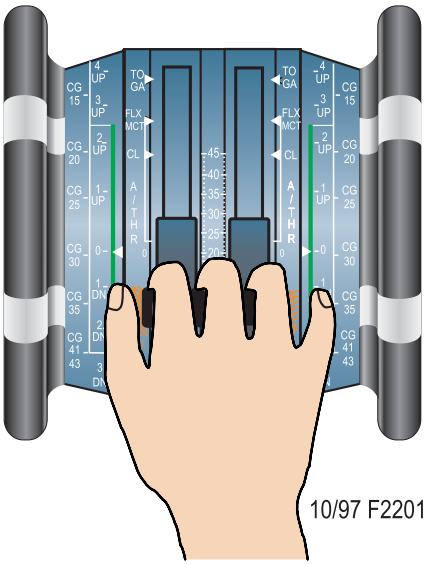

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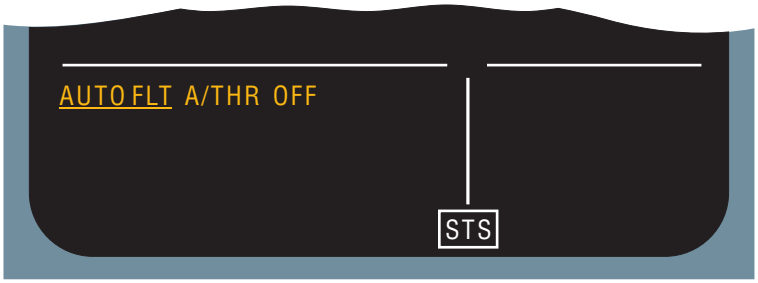

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Autothrust Indications (continued)

Autothrust Disconnect Indications (Continued)

Alternate Disconnects and Failures

A failure of the autothrust, or a disconnect using the FCU A/THR pb, is indicated by:

- an amber A/THR OFF message on the left side of the E/WD,
- an amber MASTER CAUT light, and
- a single audio chime.

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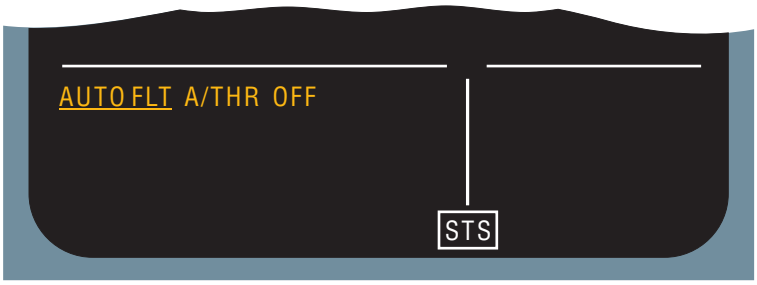

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Pressing a MASTER CAUT pb extinguishes the light. The E/WD message must be cleared manually using the ECAM CLR pb.

If the thrust levers are in the CLB or MCT detents when autothrust fails, engine thrust is frozen until the thrust levers are moved out of the detent. A thrust lock ("THR LK") FMA annunciation is provided, as shown below.

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Flight Mode Annunciations

General

The FMA displays:

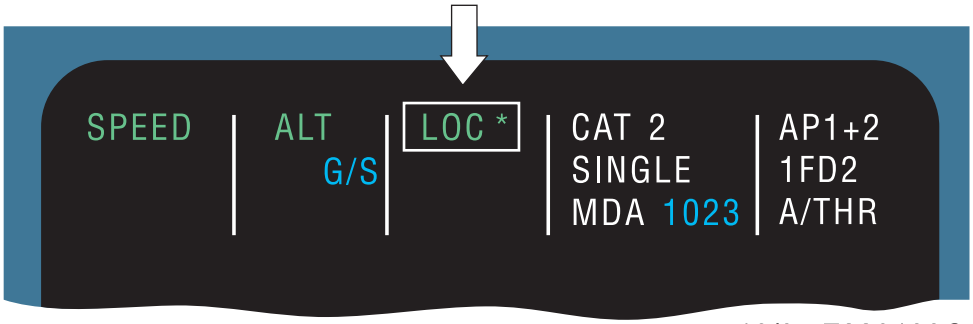
- engaged and armed flight guidance modes,
- autothrust modes and messages,
- aircraft approach capabilities and minimums, and
- the engagement status of autoflight systems.

The first three FMA columns follow these general rules:

- engaged modes are displayed in green on line 1,
- armed modes are displayed in blue on line 2,
- armed modes as a result of altitude constraints are displayed in magenta on line 2 (the annunciation is magenta only if the aircraft will level off at the constraint),
- FMS messages are displayed in white on line 3, and
- flight control messages are displayed in amber or red on line 3.

If both flight directors are selected off, and an autopilot is not engaged, all FMA annunciations (except autothrust annunciations) are blank.

FMA displays that have been changed (e.g., an armed mode which becomes engaged) are boxed for a short period, as shown below.



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Flight Mode Annunciations (continued)

General (continued)

Colors of the FMA annunciations in the following tables are indicated as follows:

- (A) amber,
- (B) blue,
- (G) green,
- (M) magenta,
- (R) red, and
- (W) white.

Autothrust Indications

Column 1 of the FMA displays autothrust modes. Active modes are displayed in lines one and two. Column 1 is blank if the autothrust system is not armed or active. A “MAN” annunciation is displayed in line 1, and a white box surrounds the autothrust annunciations when the pilot is manually controlling the thrust. The box is amber when autothrust is thrust limited by the thrust lever position, and flashes amber when TOGA lock or Alpha Floor is active.

Column 1, Lines 1 and 2

Indications and Color	Thrust Fixed or Variable	Meaning
MAN TOGA (W)	FIXED	Autothrust is armed and at least one thrust lever is at TOGA.
MAN FLX (W) XX (B)1	FIXED	Autothrust is armed, a FLEX temp has been entered in the MCDU, and at least one thrust lever is in the FLX detent.
MAN MCT (W)	FIXED	Autothrust is armed and at least one thrust lever is in the MCT detent (2 engine operations).
MAN THR (W)	FIXED	Autothrust is armed and the thrust levers are above the active range and are not in a detent (e.g., above the CLB detent with 2 engines, or above the MCT detent during single engine operations).
THR MCT (G)	FIXED	Autothrust is active (single engine operations) and at least one thrust lever is in the MCT detent, and MCT thrust is commanded.
THR CLB (G)	FIXED	Autothrust is active and at least one thrust lever is in the CL detent.

1. “XX” is the entered FLEX temperature value.

Flight Mode Annunciations (continued)

Autothrust Indications (Continued)

Column 1, Lines 1 and 2 (continued)

Indications and Color	Thrust Fixed or Variable	Meaning
THR IDLE (G)	FIXED	Autothrust is active and idle thrust is commanded.
THR LVR (G)	FIXED	Autothrust is active and the thrust lever(s) are in a position that limits autothrust authority (e.g., below the climb detent [2 engine operations] or MCT detent [single engine operations]).
SPEED or MACH (G)	VARIABLE	Autothrust is active and Speed /Mach mode is engaged and thrust will vary to hold the desired value.
A. FLOOR (G)	FIXED	Autothrust is armed and alpha floor is active and TOGA thrust is commanded.
TOGA LK (G)	FIXED	Autothrust is armed and alpha floor is no longer active. Thrust is locked at TOGA.

Column 1, line 3

A “LVR” annunciation is provided whenever the autothrust is requesting the pilot to move the thrust lever(s). Flashing annunciations are an additional indication that pilot action is required.

Indications	Meaning
LVR ASYM (A)	Asymmetry. Only one thrust lever is in the CL detent with autothrust active. (Inhibited during single engine operation.)
THR LK (A) (FLASHING)	Thrust lock. Autothrust is off (pilot deselection of FCU pb or failure) with thrust levers in CL detent (2 engines) or MCT detent (single engine), resulting in thrust being frozen until the thrust lever(s) are moved out of detent.
LVR CLB (W) (FLASHING)	The pilot should move the thrust lever(s) to the CL detent.
LVR MCT (W) (FLASHING)	The pilot should move the thrust lever(s) to the MCT detent.

Note: When the third line displays “LVR CLB”, “LVR MCT” or “THR LK”, the amber master caution light flashes and a single chime sounds every five seconds until the pilot takes the appropriate action.

Flight Mode Annunciations (continued)

Vertical Mode Indications

Column 2 of the FMA displays vertical modes. Active modes are displayed in the first line.

Column 2, Line 1

Indications	Meaning
ALT * (G)	Altitude capture mode is engaged. The altitude selected on the FCU will be captured.
ALT (G)	Altitude hold mode is engaged (the selected FCU altitude is held).
ALT CST * (G)	Altitude capture mode is engaged due to an altitude constraint. The flight plan constraint altitude will be captured.
ALT CST (G)	Altitude hold mode is engaged (the flight plan constraint altitude is held until the corresponding waypoint is sequenced).
ALT CRZ (G)	Soft altitude hold mode is engaged (the current altitude is equal to the MCDU CRZ altitude).
V/S (G)±XXXX (B)(1)	Vertical speed mode is engaged at the displayed V/S.
FPA (G)±X.X° (B)(2)	Flight path angle mode is engaged at the displayed FPA.
CLB (G)	Managed climb mode is engaged.
OP CLB (G)	Open climb mode is engaged.
DES (G)	Managed descent mode is engaged.
OP DES (G)	Open descent mode is engaged.
EXP CLB (G)	Expedite mode is engaged and the FCU selected altitude is higher than the current altitude.
EXP DES (G)	Expedite mode is engaged and the FCU selected altitude is lower than the current altitude.
SRS (G)	The Speed Reference System mode is engaged.
G/S* (G)	Glide slope capture mode is engaged.
G/S (G)	Glide slope track mode is engaged.

1. “-XXXX” is the selected vertical speed.
2. “+X.X° “is the selected flight path angle.

Flight Mode Annunciations (continued)

Vertical Mode Indications (Continued)

Column 2, Line 2

Armed vertical modes are displayed on line two.

Indications	Meaning
ALT (B)	Altitude mode is armed by selection of a proper FCU altitude (1).
ALT (M)	Altitude mode armed due to an altitude constraint entered on the MCDU. This annunciation is magenta only when the aircraft will level off at the constraint.
DES (B)	Descent mode is armed.
CLB (B)	A climb mode is armed. Will be OP CLB with selected lateral guidance. Will be CLB with managed lateral guidance.
G/S (B)	Glide slope mode is armed.
FINAL (B)	Final approach mode is armed.

Column 2, Line 2, and Line 3

Indications	Meaning
SPEED SEL : XXX (B)	Indicates a preset speed associated with the cruise or climb phase.
MACH SEL : .XX (B)	Indicates a preset MACH associated with the cruise or climb phase.

Lateral Mode Indications

Column 3 of the FMA displays lateral modes. Active modes are displayed in the first line.

Column 3, Line1

Indications	Meaning
HDG (G)	Heading mode is engaged.
TRACK (G)	Track mode is engaged.
GA TRK (G)	Go-around track mode is engaged.
RWY (G)	Runway mode is engaged during takeoff (ILS LOC signal required).
RWY TRK (G)	Runway track mode is engaged after takeoff.
NAV (G)	NAV mode is engaged.
LOC* (G)	LOC capture mode is engaged.
LOC (G)	LOC track mode is engaged.
APP NAV (G)	Lateral approach guidance is engaged.

Flight Mode Annunciations (continued)

Column 3, Line 2

Armed lateral modes are displayed on line two.

Indications	Meaning
NAV (B)	NAV mode is armed.
LOC (B)	LOC mode is armed.
APP NAV (B)	APP NAV mode is armed.

Common Mode Indications

The common mode annunciations use two columns (2 and 3) on line 1 when displayed.

Columns 2 & 3, Line 1

Indications	Meaning
LAND (G)	LAND mode is engaged.
FLARE (G)	FLARE mode is engaged.
ROLLOUT (G)	ROLL OUT mode is engaged.
FINAL APP (G)	The FINAL and APP NAV modes are engaged.

FMA Messages

A number of messages are presented on the FMA in columns 2 and 3, line 3.

Columns 2 & 3, Line 3

Indications	Meaning
MORE DRAG (W)	To meet the next vertical constraint, at least half speed brakes must be extended.
DECELERATE (W)	The aircraft has passed the top of descent point without descending.
CHECK APPR SEL (W)	A non-ILS approach is selected and an ILS has been manually tuned.
SET GREEN DOT (W)	An engine has failed, speed is selected, the aircraft is not maintaining altitude, and the speed is more than ± 10 knots from the optimum single engine speed (activating managed speed or selecting green dot corrects this condition).
SET MANAGED SPEED (W)	The aircraft has reached the flight plan cruise altitude or it has descended from the cruise altitude and speed is selected.
SET HOLD SPEED (W)	To cross the holding fix at holding speed (green dot), a deceleration should be initiated. The pilot can select green dot or use managed speed to correct this condition.
USE MANUAL PITCH TRIM (A)	The flight controls are in direct law (refer to chapter 27) and automatic pitch trim is inoperative.
MANUAL PITCH TRIM ONLY (R)	The flight controls are in pitch backup law (refer to chapter 27) and pitch is controlled with the manual trim wheel only.
VERT DISCON AHEAD (A)	DES mode is engaged, a TOO STEEP path exists on the next leg and the aircraft is less than 30 seconds from that segment.

Flight Mode Annunciations (continued)

Approach Capabilities

The aircraft approach capabilities and MDA/DA(H) are displayed in column 4.

Column 4, Line 1

Indications	Meaning
CAT I (W)	CAT I capability available.
CAT 2 (W)	CAT I capability available.
CAT 3 (W)	CAT II/III capability available.

Note: Refer to the Airway Manual for approach capability requirements for CAT II and CAT III approaches.

Column 4, Line 2

Category III landing capabilities are either FAIL PASSIVE (CAT IIIa) or FAIL OPERATIONAL (CAT IIIb). If all systems are redundant a “DUAL” capability is annunciated. If one or more systems have lost redundancy, then “SINGLE” is annunciated.

Indications	Meaning
SINGLE (W)	CAT II capability available, FAIL PASSIVE.
DUAL (W)	CAT III capability available, FAIL OPERATIONAL.

Column 4, Line 3

Indications	Meaning
MDA (W) XXX (B)	Minimum Descent Altitude (MDA) inserted on the MCDU performance APPR page (refer to Chapter 34). MDA PFD indications are based on BARO altitudes.
DH (W) XXX (B)	DA(H) inserted on the MCDU performance APPR page (refer to chapter 34). DA(H) PFD indications and aural callouts (“100 ABOVE” and “MINIMUMS”) are based on radar altitudes. These two aural callouts only occur when a numerical value has been entered for a DA(H).

Note: Due to Display Management Computer (DMC) resolution, a discrepancy of up to 4 feet may occur between the MDA or DA(H) entered in the MCDU and displayed on the FMA.

Flight Mode Annunciations (continued)

AP/FD A/THR Engagement Status

The engagement status of the autopilots, flight directors, and autothrust systems are displayed in column 5.

Column 5, Line 1

Indications	Meaning
Blank	Neither autopilot is engaged.
AP 1 (W)	Autopilot 1 is engaged.
AP 2 (W)	Autopilot 2 is engaged.
AP 1 + 2 (W)	Autopilots 1 and 2 are engaged.

Column 5, Line 2

A dash indicates that the corresponding FD is off. The captain's FD (1) is normally displayed first. If a "2" is displayed first, it indicates that FD 1 has failed. The same logic applies to FD 2:

Indications	Meaning
Blank	Both flight directors are off.
1FD2	Normal configuration: both FD's are on and operating normally.
-FD2	FD1 is off, FD 2 is on.
1FD-	FD1 is on, FD 2 is off.
1FD1	Both FD's are on; FD 2 is inoperative.
2FD2	Both FD's are on; FD 1 is inoperative.

Column 5, Line 3

Indications	Meaning
Blank	Autothrust is off (manual thrust).
A/THR (B)	Autothrust is armed.
A/THR (W)	Autothrust is active.

Chapter 23: Communications

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System Description

General Description

Description

The aircraft is equipped with several communication systems which include:

- VHF and HF radio communication,
- internal communication,
- cabin visual and audio signaling, and
- Cockpit Voice Recorder (CVR).

Major components include:

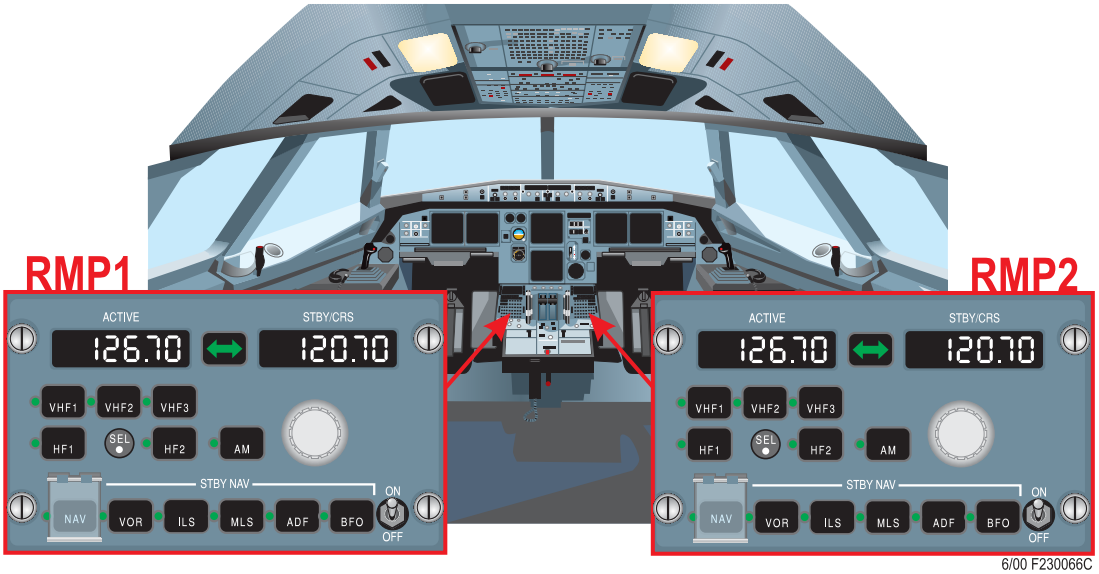
- Radio Management Panels (RMP),
- Audio Control Panels (ACP),
- Cabin Intercommunication Data System (CIDS),
- Public address system,
- CALLS system, and
- Cockpit Voice Recorder (CVR).

Radio Management Panel (RMP)

Function

Two RMPs are located on the center pedestal, one next to each pilot. The RMP is used for:

- Selecting a desired radio for the purpose of:
  - viewing the active and standby frequencies
  - changing the active and standby frequencies
  - transferring the standby frequency to the active
- The selection of standby navigation (STBY NAV) tuning.



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Radio Communication

Each RMP contains the switching controls for the communication radios. Either RMP can tune any of the three VHF radios. The selected radio is indicated by a green light to the left of the radio key. VHF1 is selected in the example below.

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Note: A320 ships: 3217, 3218, and 3219 are equipped with one HF radio.
A320 ships: 3239, 3240, 3241, and 3243 have two HF radios.

Radio Management Panel (RMP) (continued)

Radio Communication (continued)

Tuning

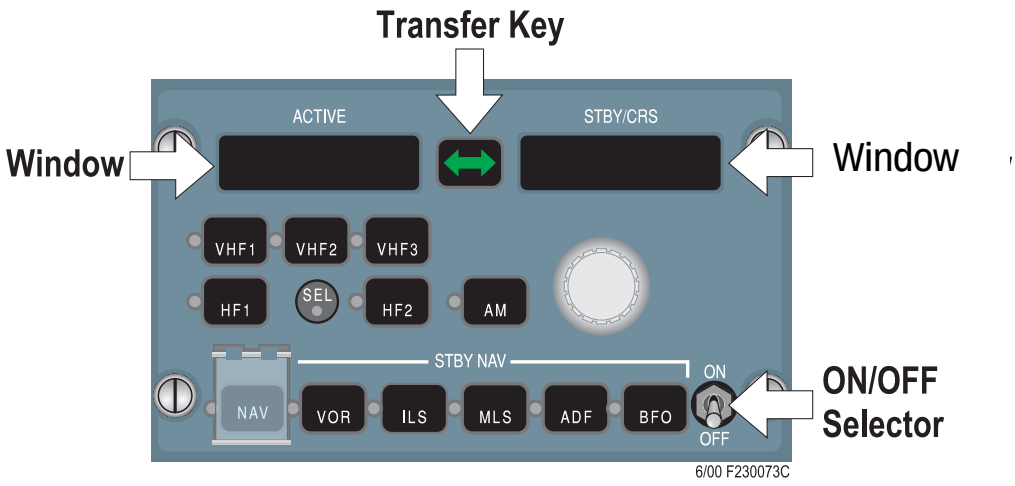
A rotary selector located on the RMP is used to select the desired radio frequency. Two display windows on each RMP provide a visual presentation of:

- ACTIVE frequency on the left
- standby (STBY/CRS) frequency on the right

To make the standby frequency active, the pilot must push the transfer key located between the two display windows.

RMP ON/OFF Selection

RMP power selection (ON/OFF) is accomplished with a switch located on the lower right corner of the RMP. If the display windows are blank with the ON/OFF toggle switch selected ON, the RMP has lost its power source or has failed.



RMP Failure

If an RMP failure occurs, the other RMP can be used as a backup to select any radio. An ECAM STATUS message appears indicating which RMP has failed.

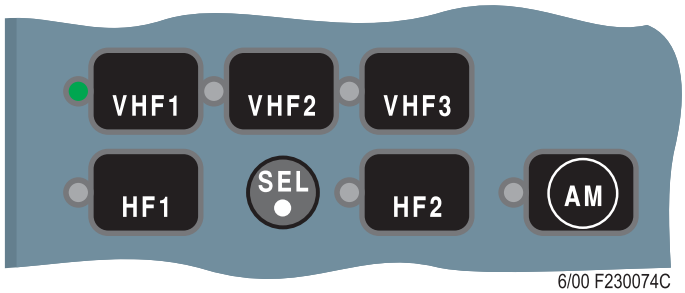
Radio Management Panel (RMP) (continued)

Normal Radio Operation

In normal operation, the radios are used in the following manner:

VHF1

- Ground, tower, departure, approach, and enroute ARTCC frequencies.



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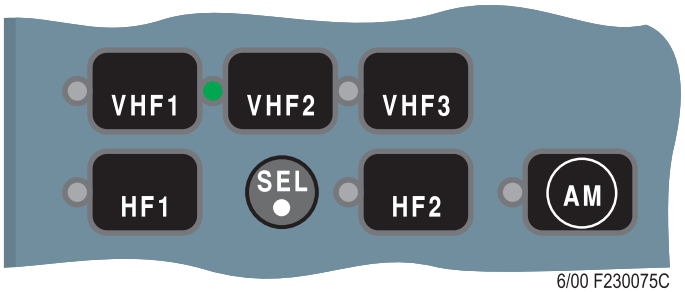
VHF2

- Local gate radio, local ramp, ATIS, and clearance delivery.



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VHF3

- ACARS.

Note: VHF3 can also be tuned and used as an additional communication radio. Selection and tuning are performed through the MCDU. This option may be used when the ACARS is inoperative.

Radio Management Panel (RMP) (continued)

Standby Navigation (STBY NAV)

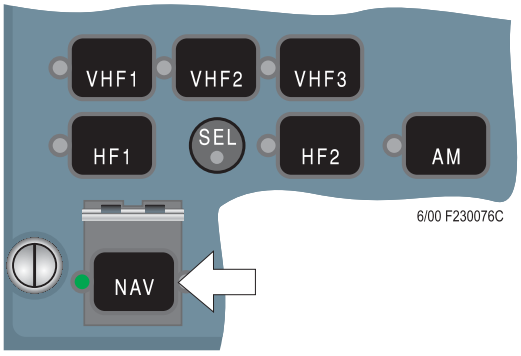
Navigation radios are normally tuned by the Flight Management and Guidance Computers (FMGCs). In the case of dual FMGC failure, the RMP can be used to select navaid frequencies for standby navigation.

STBY NAV tuning is required when:

- both pilots' FMGCs are inoperative
- when the aircraft is in the emergency electrical configuration.

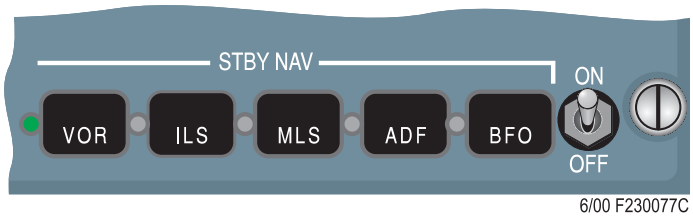
STBY NAV keys located at the bottom of the RMP provide the following results when selected.

NAV - This guarded key puts the RMP in the standby navigation mode and inhibits auto tuning from the FMGC.



Note: When standby tuning is desired, the NAV keys on both RMPs (if operable) are selected on. The STBY NAV keys then become operative.

VOR, ILS, MLS, ADF - The STBY NAV keys allow the tuning of the selected navaid via the rotary selector. The desired navigation radio is selected with the appropriate key. In the example below, the VOR is selected, as indicated by the green light to the left of the VOR key. The frequency and course (if applicable) are displayed in the display windows.



Note: Beat Frequency Oscillator (BFO) is not used by Delta.

Note: The RMP provides both communication radio tuning and standby navigation radio tuning. The selection of standby navigation tuning with the NAV key does not affect subsequent tuning of the communications radio. The green selected radio light is displayed to the left of the selected radio (either communication or navigation). In the example above (with the VOR selected), the pilot can change VHF1 frequencies by pushing the VHF1 key and proceeding as previously described.

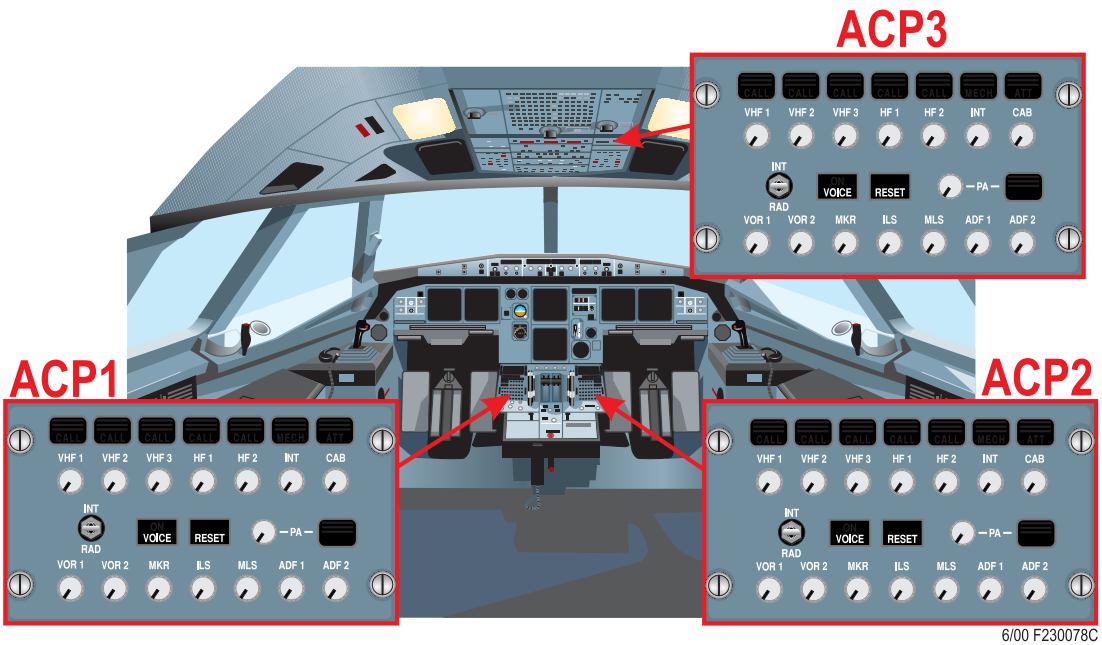
Audio Control Panel (ACP)

Function

There are three ACPs. Two are located on the pedestal, next to each pilot. The third is located on the overhead panel, accessible to both pilots and a jumpseat rider.

The ACP is used for selecting transmit and reception options. The ACP has controls for:

- transmitting on a selected radio,
- selecting the desired radio for transmitting and receiving,
- adjusting the volume of selected radios,
- talking on the public address system,
- resetting a cockpit call, and
- filtering to monitor voice communications from a navaid.



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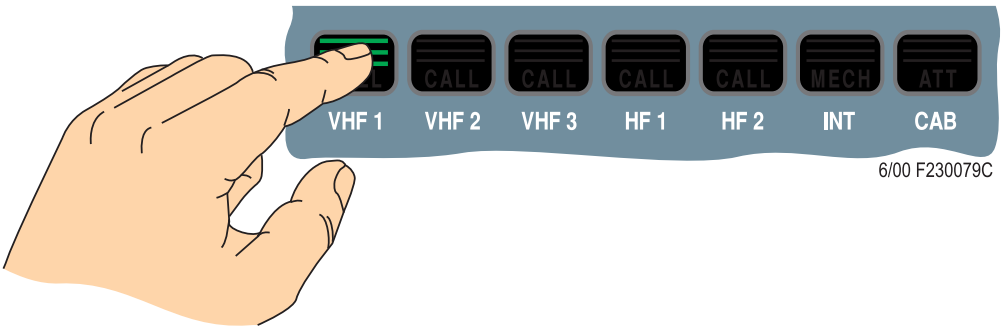
Audio Control Panel (ACP) (continued)

Audio Transmission

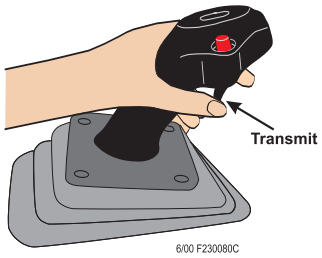
Transmission keys, located across the top of each ACP, are used to select the desired radio for transmitting. Pushing the key illuminates the green light and selects the desired radio. A second push deselects that radio. Only one key can be selected at a time. The selection of a new key automatically deselects the previous key.



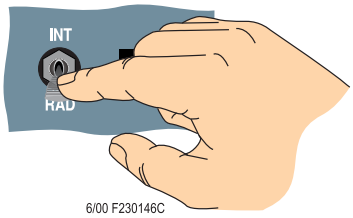
Note: Selecting a transmission key **does not** provide audio reception.

Once the radio has been selected, transmitting is accomplished by one of the following:

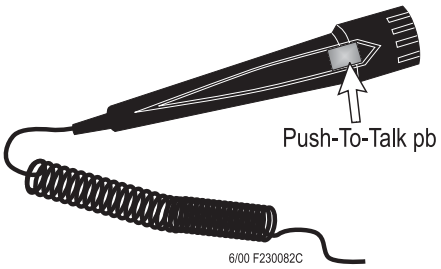
- squeezing the trigger on the pilots' sidestick and speaking into the boom microphone or oxygen mask microphone,



- holding the spring loaded INT/RAD switch on the ACP to the RAD position and speaking into the boom microphone or oxygen mask microphone, or



- holding the push-to-talk pb on the hand microphone and speaking into the hand microphone.



Audio Control Panel (ACP) (continued)

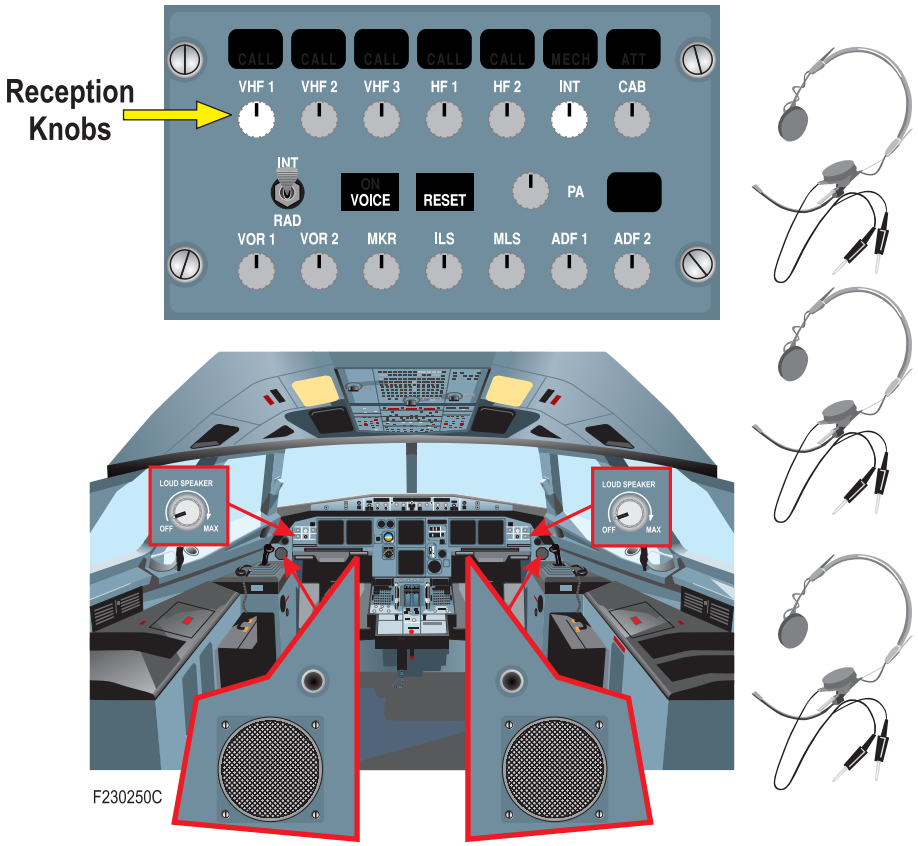
Audio Reception

Audio reception is achieved by selecting a reception knob located on an ACP. When monitoring of a particular broadcast is desired, the respective reception knob is pressed and released. The selected knob illuminates (white) to indicate that its associated broadcast can be monitored. In addition, each knob controls reception volume.

Regardless of which reception knob is selected, the broadcast can be monitored over the respective headset and/or the associated flight deck loudspeaker.

When monitoring is no longer required, the reception knob is once again pressed and released. The light extinguishes indicating that the broadcast is not being monitored.

Note: Unlike the transmission keys of an ACP, numerous receptions knobs can be simultaneously selected and all selected broadcasts can be monitored.



Flight Deck Head Sets

The flight deck is equipped with three headsets. One for each pilot and one for the third occupant. A headset is not provided for the fourth crewmember. Each headset's boom microphone can be used to transmit over the respective ACPs selected radio.

Flight Deck Loudspeakers

The flight deck is equipped with two voice communication loudspeakers. Located on each pilot's forward instrument panel, each speaker's volume can be individually controlled by the associated LOUD SPEAKER volume knob.

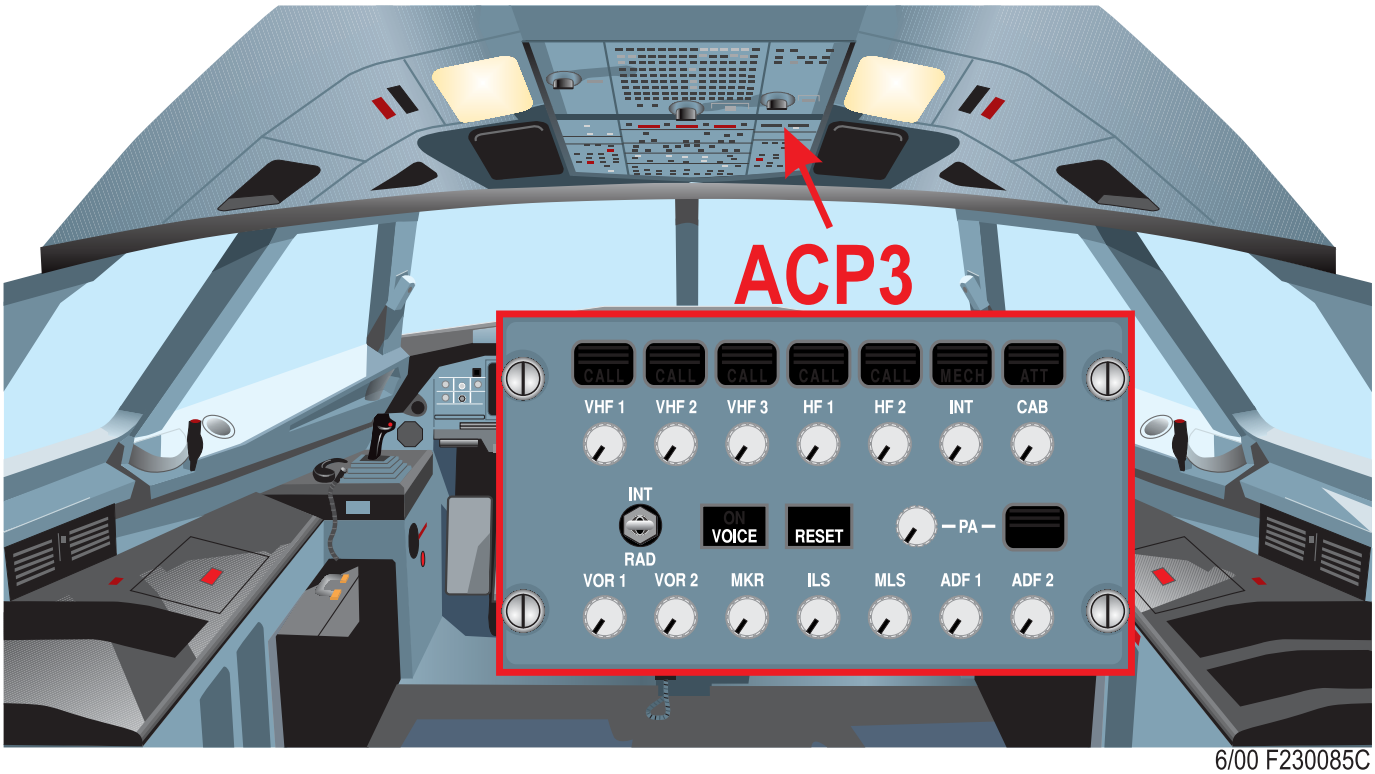
Note: The LOUD SPEAKER volume control knob does not control/affect the volume of any aural warnings or alerts.

Audio Control Panel (ACP) (continued)

ACP Failure

If a failure of a pilot's ACP occurs, the third ACP, located on the overhead panel, can be selected by using the AUDIO SWITCHING control knob on the aft overhead panel. The pilot then makes all ACP selections from ACP3.

If the AUDIO SWITCHING control knob has been selected to ACP3, an ECAM message AUDIO 3 XFRD appears in the memo section.



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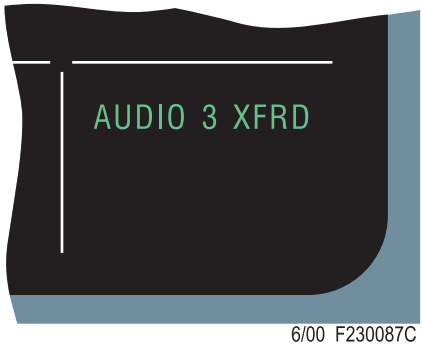

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Note: The third occupant's headset is inoperative with the AUDIO SWITCHING control knob out of the NORM position.

Cabin Intercommunication Data System (CIDS)

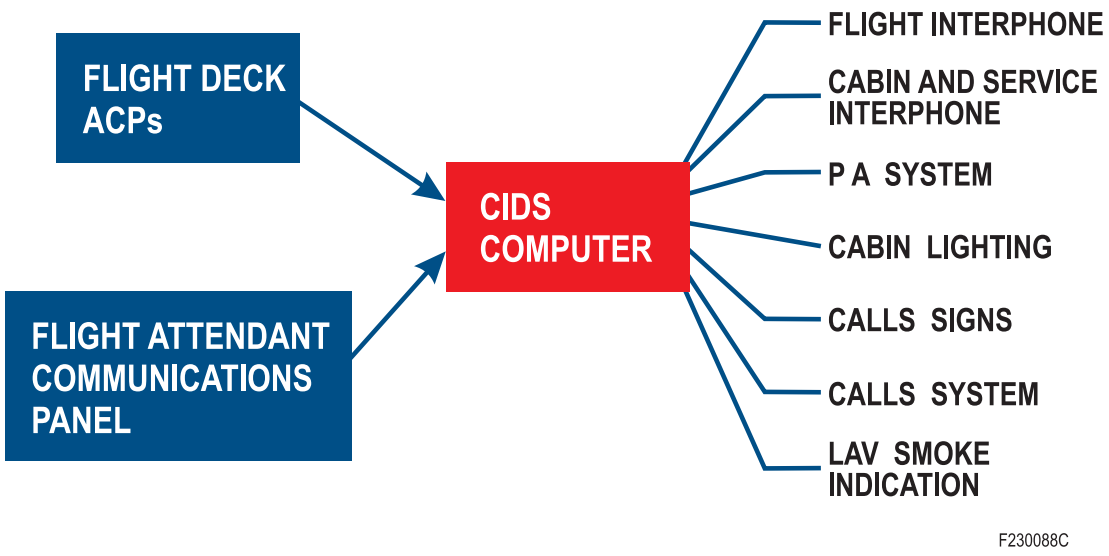
Description

Intercommunication throughout the aircraft cabin is controlled electronically by the cabin intercommunication data system (CIDS) computers. The inoperative status of a CIDS system is displayed on the ECAM.

The CIDS system controls:

- flight interphone,
- cabin interphone (interior),
- service interphone (exterior),
- PA system,
- cabin lighting (normal and emergency),
- cabin signs,
- CALLS system, and
- lavatory smoke detection.

Relationship Diagram



Interphone Systems

Introduction

The aircraft's interphone systems permit communication to and from specific locations throughout the aircraft. They are referred to as the:

- Flight Interphone System
- Cabin Interphone System
- Service Interphone System

Flight Interphone System

The Flight Interphone System permits communication between the:

- flightdeck crewmembers when headset/boom microphone use is required, or
- flightdeck crewmembers and ground personnel at the External Power Panel, such as during aircraft pushback.

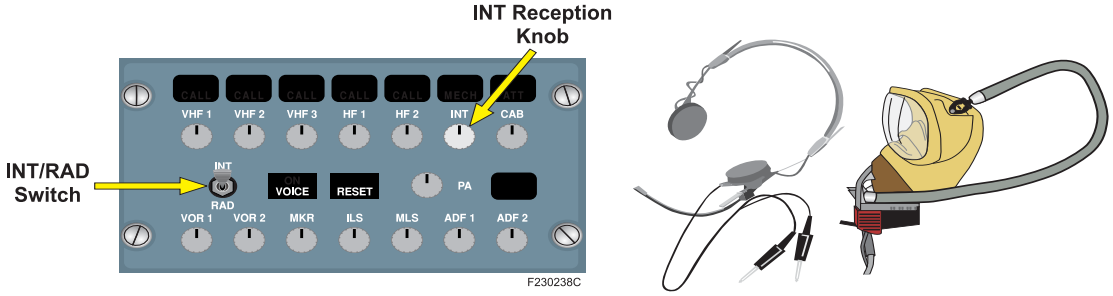
From the flightdeck, the Flight Interphone System is accessed using an ACP by either:

- placing the INT/RAD switch to the INT position, or
- selecting the INT transmission key.

Using the INT/RAD switch in the INT position:

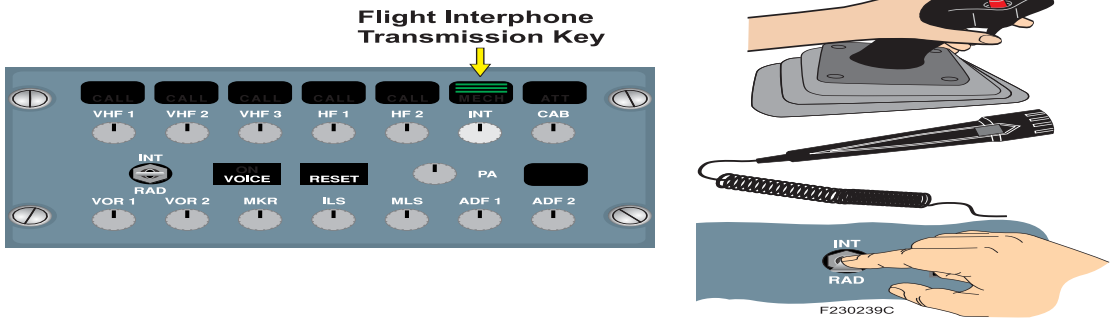
Permits hands free transmittal over the Flight Interphone System using either a headset boom or oxygen mask microphone. Reception will require the selection of the INT reception knob of the ACP.

Note: When the INT position is selected, the associated boom microphone is active, i.e., 'hot Mike'. Any and all conversations picked up by the boom microphone will be transmitted over the Flight Interphone System.



Using the INT/RAD switch in the RAD position::

Allows the pilot to transmit over the respective RWPs selected radio via the headset boom mike or oxygen mask microphone. The switch is spring loaded from the RAD to the center position, i.e., a push to talk toggle switch.



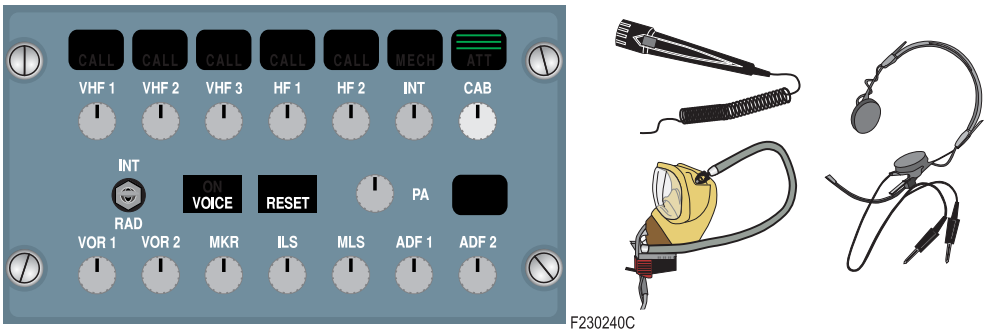
Interphone Systems (continued)

Cabin Interphone System

The Cabin Interphone System permits communication between the:

- flightdeck and cabin,
- flight deck and the External Service Interphone jacks, or
- flight Attendant stations

From the flight deck, transmittal over the Cabin Interphone System requires the selection of the CAB transmission key of an ACP. Transmission can be made using the headset boom, oxygen mask, or hand microphones. Reception requires the selection the reception knob of the ACP.

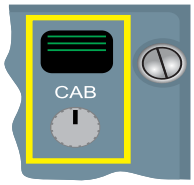


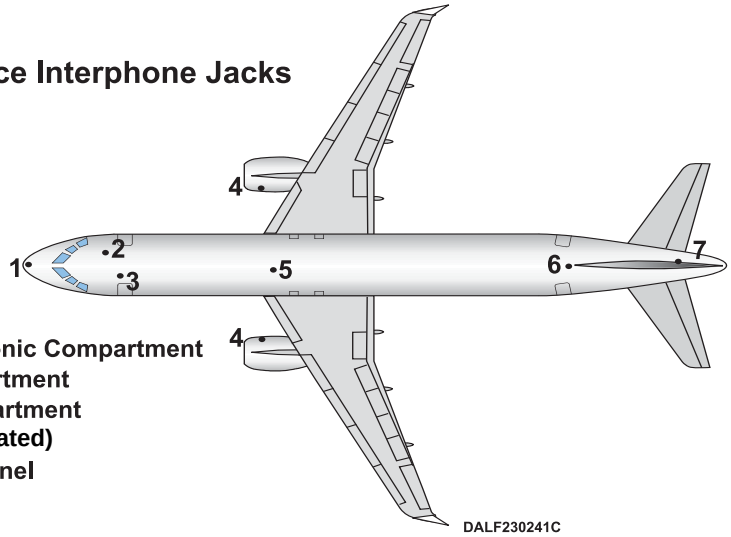
Service Interphone System

The Service Interphone System permits communication to and from various exterior locations of the aircraft and the flight deck.

The Service Interphone System is accessed by selecting the CAB transmission key of an ACP. Transmission can be made using the boom, oxygen mask or hand microphone. Reception requires the selection the reception knob of the ACP.

External Service Interphone Jacks





1 Forward Electronic Compartment
2 Electric Compartment
3 Avionics Compartment
4 Engine (deactivated)
5 Belly Fairing Panel
6 Aft Fuselage
7 Near Apu Bay

Interphone Systems (continued)

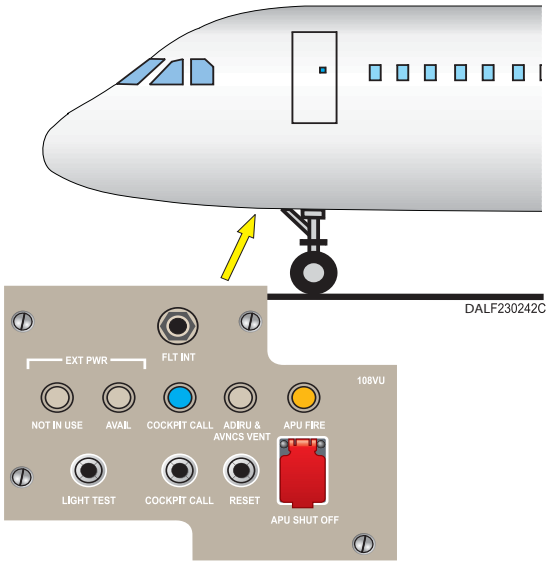
External Power Panel

From the External Power Panel, located aft of the nose landing gear, ground personnel are able to communicate with the flight deck using the Flight Interphone System.

In addition, from the External Power Panel, ground personnel can:

- signal the flight deck,
- receive signals from the flight deck, or
- reset any calls from the flight deck.

Note: The FLT INT jack on the External Power Panel is the only exterior connection of the Flight Interphone System and is not associated with the Service Interphone System.



Public Address System

Description

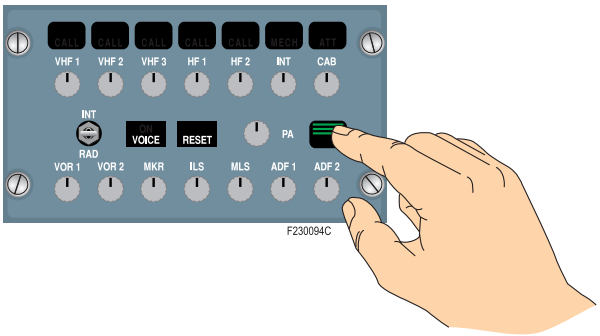
The Public Address (PA) system provides a means for the pilots and the flight attendants to make announcements over loud speakers located in the passenger cabin.

From the Flight Deck

From the flight deck, the PA system is accessed by one of two means. Either by utilizing the controls on an ACP or by using the flight deck handset.

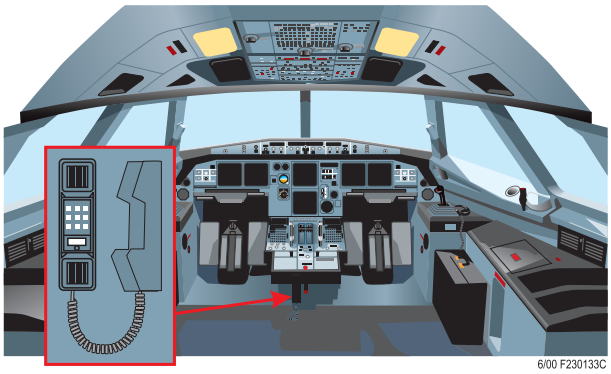
Using an ACP - By pressing and holding the PA transmission key of an ACP, a PA can be made using the headset boom, oxygen mask, or handset microphones.

Note: The PA transmission key is a spring loaded switch and must be held down while making the PA. When held down, any other selected transmission key will be temporarily inhibited preventing PA transmission over a radio.



Using the Flight Deck Handset - Use of the flight deck handset simply requires lifting the handset from its cradle and pressing and holding the Press-to-Talk (PTT) button on the handset. Use of the handset does not require any selection on an ACP.

Note: Line operation use has proven that the use of the handset provides better clarity over the use of the ACP PA transmission key.



From the Cabin

From the cabin, a PA can be made using the FA handsets located at the forward and aft Flight Attendant Stations.

Monitoring PAs

All public addresses can be monitored on the flight deck by selecting the PA reception knob of an ACP or by using the flight deck handset. Using the handset does not require the use of an ACP PA reception knob.

Cabin Calls System

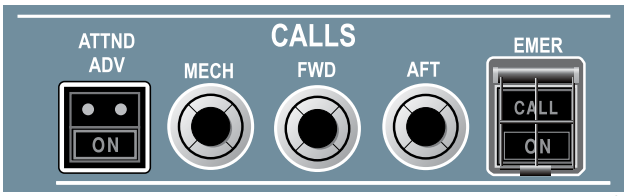
Description

The Cabin Calls System is designed to provide both visual and audio signals to facilitate communication between the flight deck and the passenger cabin.

The system also provides signals between the flight deck and ground personnel.

Calls from the Flight Deck

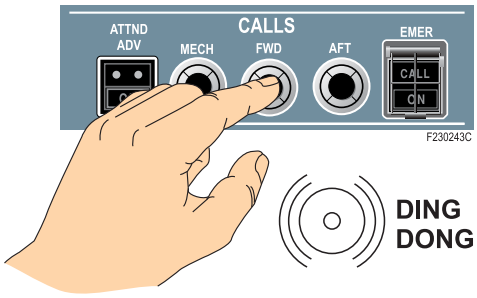
Using the CALLS panel located on the flight deck's overhead panel, the pilots can signal the cabin crew or ground personnel.



The FWD pb is selected when communication is desired with the forward cabin.

.The following signals will be triggered:

- a high/low chime sounds at the forward cabin,
- a pink light illuminates on the forward area call panel, and
- CALL CAPTAIN message appears on the forward attendant indication panel (AIP) along with the illumination of a red light.



The AFT pb is selected when communication is desired with the aft cabin.

The following signals will be triggered:

- a high/low chime sounds at the aft cabin,
- a pink light illuminates on the aft area call panel, and
- CALL CAPTAIN message appears on the aft AIP along with illumination of a red light.

Cabin Calls System (continued)

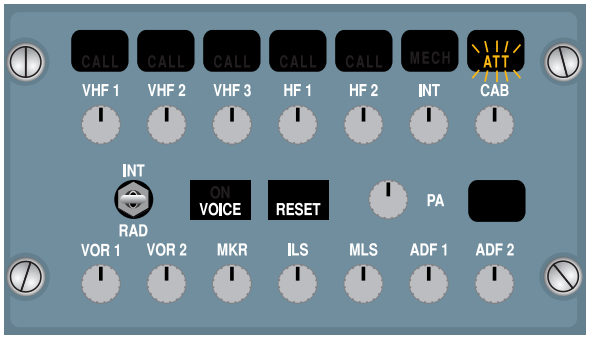
Calls from the Cabin

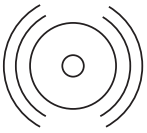
A call being received from the cabin to the flight deck is signaled by the following indications:

- a single buzzer sound on the flight deck, and
- a flashing ATT light Illuminates on the CAB key of all three ACPs.

Note: The buzzer is inhibited during takeoff below 1,500 ft. and on approach below 800 ft. (only the ATT light flashes).

The flashing ATT light can be extinguished by pressing the RESET pb located on the ACP. A reset automatically occurs after a short time if no action is taken.





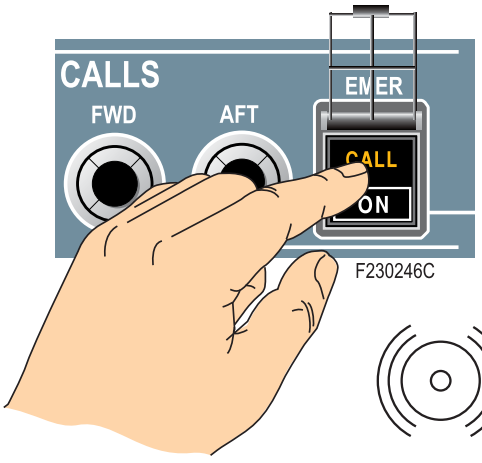
Buzz

Emergency calls to the Cabin

The guarded EMER pb on the CALLS panel is used in the case of an emergency or when immediate contact with the cabin crew is required.

The following signals will be triggered:

- on the EMER pb, ON flashes white and CALL flashes amber,
- three high/low chimes consecutively sound at the forward and aft cabin areas,
- two pink lights flash on the forward, mid and aft area call panel, and
- the message EMERGENCY CALL appears of the forward and aft (AIP) along with a red light.



Attendant Indication Panels

Area Call Panels

DING DONG

DING DONG

DING DONG

Cabin Calls System (continued)

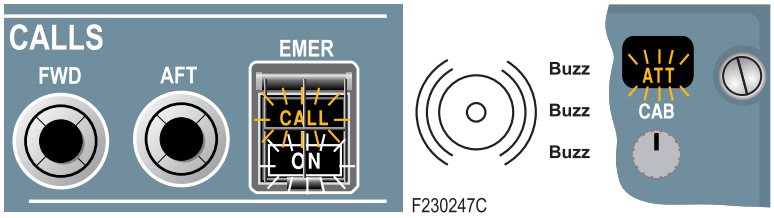
Emergency Calls from the Cabin

The EMER CALL key located on the flight attendant's handset is used in the case of an emergency or when immediate contact with the flight deck is required.

The following signals will be triggered:

- three consecutive buzzers sound on the flight deck,
- on the EMER pb, ON flashes white and CALL flashes amber, and
- ATT flashes amber on all ACPs.

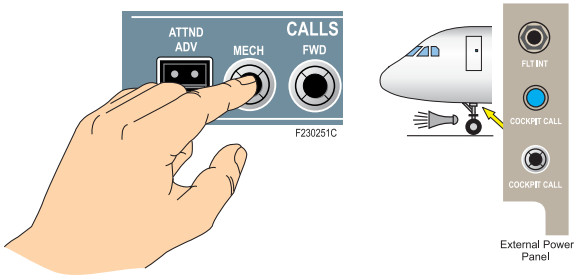
Note: The buzzer is inhibited during takeoff below 1,500 ft. and on approach below 800 ft. (only the lights on the EMER pb will flash).



Call to Ground Personnel

The flight deck crew can get the attention of ground personnel by pressing the MECH pb on the CALLS panel. The following signals will be triggered:

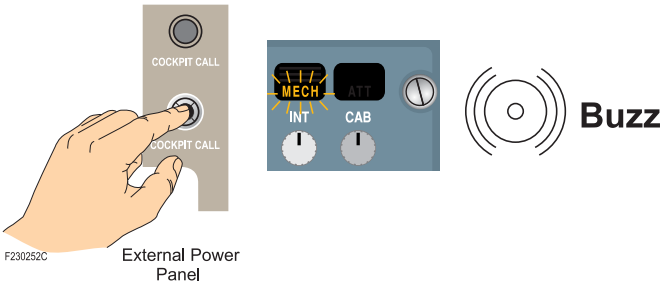
- a horn sounds at the nose area of the aircraft as long as the MECH pb is held,
- a blue COCKPIT CALL light illuminates on the External Power Panel.



Call from Ground Personnel

Ground personnel can get the attention the flight deck by pressing the COCKPIT CALL pb on the External Power Panel. The following signals are triggered:

- illuminates a flashing "MECH" light in the INT pb on all three ACPs. If not reset on an ACP, light will extinguish after 60 seconds, and
- sounds a buzzer in the flight deck. Buzzer stops when the COCKPIT CALL pb is released.



Flight Attendant Advisory (not used by Delta)

Description

The Flight Attendant Advisory (ATTND ADU) is a one-way communication signal from the flight deck to the cabin. It was used by the pilots to signal the flight attendants not to enter the flight deck during periods of flight deck high workload.

Cockpit Voice Recorder (CVR)

Function

The cockpit voice recorder (CVR) records and retains the last 30 minutes of:

- conversations between crew members,
- all aural warnings in the cockpit,
- communications received and transmitted by radio,
- interphone conversations between crew members, and
- announcements transmitted over the PA from the cockpit.

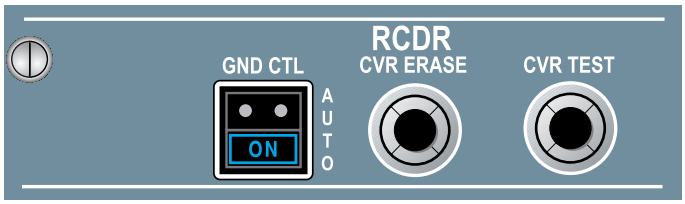
Note: The CVR only records PA transmissions from the flight attendants to the passengers if a PA volume control knob on the third ACP is selected ON.

Operation

The Digital Flight Data Recorder (DFDR) shares the same circuitry and is activated whenever the CVR is activated. Both CVR and DFDR are activated:

- for 5 minutes when the aircraft electrical system is energized,
- after the first engine start, and
- anytime in flight.

The controls for manual operation, testing the CVR, and erasing the tape, are located on the overhead RCDR panel.



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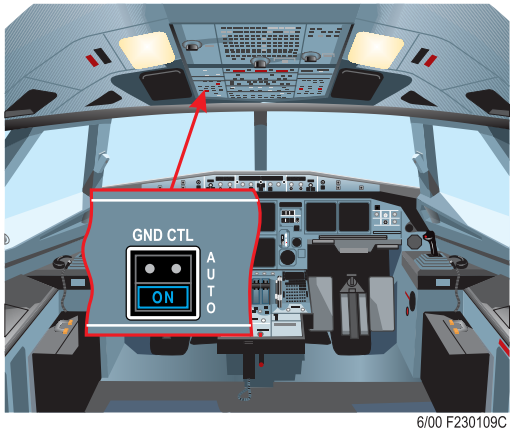
The GND CTL pb, located on the RCDR panel, allows the pilot to activate the CVR when electronic logic has automatically deactivated it.



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Onboard WI-FI

Introduction

The A319/A320 fleet has been modified to provide passengers traveling within the continental United States with high-speed internet capability.

Description

Major components include:

- Aircell Broadband Services (ABS) Control Processor Unit and ABS Air to Ground Communications Unit located in the avionics compartment,
- three externally mounted antennas,
- six cabin wireless antennas,
- ON/OFF internet master switch (cabin),
- circuit breaker (cabin panel - Door 1 overhead), and
- cabin handset (located in cabin @ Door 2L).

Function

This system is only accessible above 10,000 feet, will switch ON/OFF automatically, and requires no flight deck crew interaction.

System Overview

Passengers can access the internet via WI-FI access points installed in the cabin. The system is powered when the GALLEY pb has powered the galley buses.

Aircraft Communications Addressing and Reporting System (ACARS)

Introduction

ACARS is a communications system providing a data link between the aircraft and a ground-based communication network. Information is sent as a digital signal and can be transmitted over VHF radio, HF radio, or via satellite, depending on aircraft equipment. On aircraft only equipment with VHF ACARS link, there are gaps in coverage over ocean areas and some remote land masses. Aircraft equipped with SATCOM (SATellite COMmunications) or HFDL (High Frequency Data Link) systems can communicate via the ACARS system worldwide.

Various companies provide data communications networks throughout the world. The specific VHF frequency for datalink operations is determined by the company that provides the ground network for the geographic region. The system allows both manual and automatic communications.

- Events such as OUT, OFF, ON, and IN times are downlinked automatically as they occur.
- Pilot requests may be uplinked to the aircraft, such as:
  - pre-departure ATC clearances
  - weather
  - load data
  - performance data
  - gate assignments
- Reports from the aircraft can be manually downlinked to the ground-based facility, such as:
  - company position reporting
  - in-flight weather conditions
  - maintenance logbook entries
  - in-range reports

Note: Refer to the Airway Manual section for geographic ACARS coverage.

Location

The ACARS function is accessed through either or both multi-purpose control display units (MCDUs). The management unit (A320) or the air traffic services unit (ATSU) on the A319 is located in the avionics bay.

VHF Radio

VHF 3 is normally dedicated for use with ACARS.

Frequency Tuning

For domestic operations, the ACARS VHF frequency for the communication network is automatically tuned for use. ARINC, the service provider for North America, uses a “base frequency” of 131.55Mhz. However, to relieve frequency congestion, they can automatically (remotely) tune the ACARS frequency to other frequencies (e.g. 129.125, 130.025). Even though this remote tuning by ARINC is transparent to the flight crew, the active frequency can be viewed on the COMM-DATA page. Communication networks outside of the domestic U.S. may require selection.

Aircraft Communications Addressing and Reporting System (ACARS)

Message Routing

Messages from the aircraft are transmitted to the nearest ground station.

- Flight number, ship number, time and date are automatically included as part of the message.
- The ground station relays the message to the communication network's central computer (in ARINC's domestic U.S. system, this computer is located in Annapolis, Maryland).
- The central computer processes the message and sends it to a message routing computer at Delta Air Lines, or directly to the ATC computer systems for transactions they process, such as ATIS and oceanic clearances. There the message is routed to the user or to an internal database to access the necessary information.
- Messages from the ground are generated in the Flight Planning System (FPS) and sent through the message handling computer to ARINC. ARINC then routes the message along its ground lines to the appropriate VHF station where it is sent to the aircraft.

Glossary

Key Words

The following table lists key words and phrases used by the ACARS system.

ACARS or AOC Menu	The main menu of the ACARS system.
Alpha	A letter as opposed to a numeral. ACARS logic does not accept a numeral in a data field designated for a letter.
Downlink	Refers to the transmission of data from the aircraft to a ground-based facility.
EON	Estimated On Time at landing airport (does not include taxi in time).
Field	A line of text on a data screen.
Free Text	A message formed with letters and/or numerals and entered into the data display by the pilot. This message may be downlinked in the same manner as any ACARS message.
LSK	Line Select Key. The twelve keys, six on the right and six on the left, adjacent to the display screen of the MCDU are used to select the adjacent item on the screen. In addition, they are used to move data from the scratchpad line to the appropriate data line.
Numeric	A numeral as opposed to a letter. ACARS logic does not accept a letter in a data field designated for a numeral.
Page	Refers to the data display. Functions such as engine data and logbook write-ups may use multiple pages.
Received Messages	Those messages sent from a ground-based facility to the aircraft (uplinked).
Sub-Menu	Those items on the main menu where more than one choice may be selected.
Uplink	Refers to the transmission of data from a ground-based facility to an aircraft.

ACARS Advisories

Function

The bottom line (MCDU scratchpad area) on each MCDU page is used to display advisories. The following table lists the messages and their meanings.

Message	Meaning
VHF LINK ARMED	A downlink has been manually initiated. Once the ground station receives the downlink, the page automatically reverts to the MAIN MENU.
NO COMM-MSG QUEUED	Appears if a link with a ground station cannot be made. Messages will be stored in memory and automatically downlinked when in range of a ground station.
VOICE GO AHEAD	A message has been received requesting normal voice communications. View the message from the Received Messages Menu.
VOICE SELECTED	VOICE mode has been selected by changing the frequency of VHF 3 on the RMP. The VOICE SELECTED advisory and the ECAM message VHF 3 VOICE is displayed.
TEXT BUFFER FULL	No additional characters can be entered on the Free Text or Remarks pages.
MESSAGE WAITING	An uplink message has been received.
LOAD REVISION	A revision to the load advice has been uplinked to the aircraft.
FLT DISAGREE	The flight number, route, or date uplinked in the load advice disagrees with the Flight Data page.
ENTER FUEL DATA	Fuel on departure on the Flight Data page has not been loaded between the OUT event and OFF event. Also appears if the fuel remaining field on the Arrival Data page is not loaded between the IN event and the transmitting of the IN event data.
ENTER ID DATA	The fields CAPT ID and/or FO ID on the Flight Data page are not loaded between the OUT event and OFF event. Also appears if the T/O ID or LAND ID Menu is not loaded on the Arrival Data page between the ON event and the transmitting of the IN event data.
GATE REVISION	A revision to the gate assignment has been uplinked to the aircraft.
INVALID ENTRY	Attempting to load data that is out of range, entering numeric data into an alpha field, or alpha data into a numeric field.

ACARS Advisories (continued)

Function (continued)

MU FAILURE	Appears when an ACARS fault is detected in the airborne avionics of the ACARS system.
SEND TAXI DLY RPT + PA	Appears if taxi-out time has exceeded the scheduled taxi time by ten minutes without any update by the flight crew.
SEND GATE ETA RPT + PA	Appears if the taxi-in time exceeds the scheduled taxi time published on the flight plan by ten minutes without update.

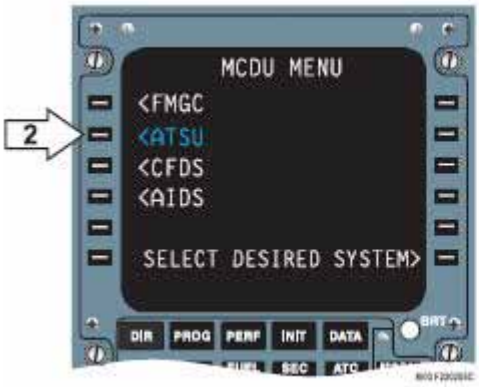
ACARS MENU

Access (A320, 3201-3270)

The main ACARS MENU is accessed by pressing the MCDU MENU key (1) on the MCDU, then selecting <ACARS (2). The desired page or sub-menu may be selected from the ACARS MENU by pressing the appropriate LSK.

Access (A320, 3271 & up, All A319)

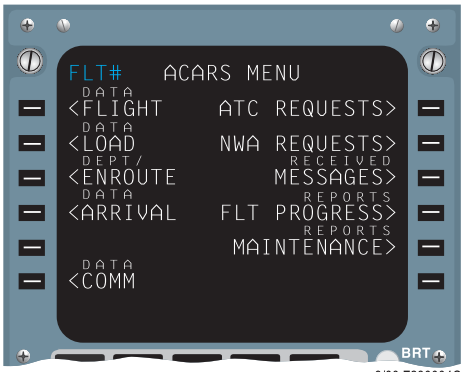
The main ACARS MENU is accessed by pressing the MCDU MENU key (1 above) on the MCDU, then selecting the <ATSU prompt (2) followed by >AOC prompt (3). The desired page or sub-menu may be selected from the ACARS menu by pressing the appropriate LSK.



FLT DATA Page

Function

Pressing LSK 1L on the ACARS MENU displays the FLT DATA 1/2 page.



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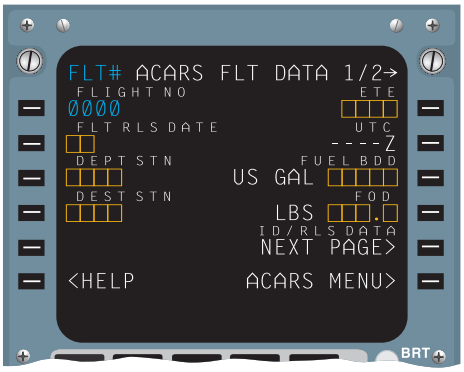

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Note: The information on this page remains in the ACARS system data base and automatically is included in all downlinked messages.

FLIGHT NO.

Enter the appropriate flight number. Do not enter flight number suffixes (e.g., 463A). For A319 aircraft, the flight number is inserted automatically when the FMGC Init page flight number field is completed.

FLT RLS DATE

Enter the date shown on the flight release. This date is the scheduled originating local date of the first flight of a multi or single segment flight number and may differ from the current date. Example: the sixth day of the month would be typed in as 06.

DEPT STN

Enter the 4-letter ICAO code for the departure station (e.g., KATL, KDTW). Although the system allows four character entries, only three letter city codes must be used. The previous DEST STN is automatically inserted in this line when the IN message is sent.

DEST STN

Enter the 4-letter ICAO code for the arrival station (e.g., KMSP, KLGA). On a through flight, do not enter a new destination city code until the IN event has been sent.

ETE

Enter the estimated time enroute (ETE), in hours and minutes, from the computer flight plan (e.g., 230 for 2 hours and 30 minutes).

UTC

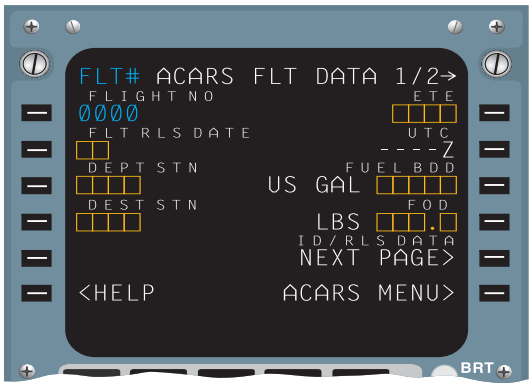
The UTC time is automatically updated from the ACARS network upon initial power up, or taken from the aircraft clock for ATSU-equipped aircraft.

FLT DATA Page (continued)

FUEL BDD — Enter “0” to satisfy screen logic.

FOD — Enter the total fuel on departure (FOD) before engine start at the gate (e.g. 36,000 lbs = 36.0). If this entry is not made, the ENTER FUEL DATA advisory appears after the OUT event. If this value exceeds flight release tolerances, an alert is sent to the Dispatcher and an uplink is sent advising the crew of the necessary action.

ID/RLS DATA — Select the next page prompt (5R) or the Next Page Key on the MCDU to access page 2/2 of flight data.



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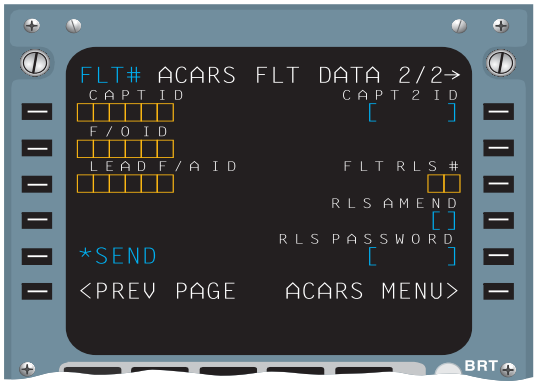

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FLIGHT DATA 2/2 — The asterisk automatically appears next to the send prompt when all required data is entered.

CAPT ID — Enter the captain's employee number.

F/O ID — Enter the first officer's employee number.

F/A ID — N/A

CAPT 2 ID — Enter the second captain’s employee number when an augmented crew is necessary.

FLT RLS — Enter the flight release number as indicated on the Dispatch release paperwork.

RLS AMEND — If the release was amended, enter the release amendment number as indicated on the Dispatch release.

FLT DATA Page (continued)

RLS PASSWORD This field is for flight release electronic signature. It is reserved for future growth.

FPS UPLINKS After all data is entered, press SEND. FPS compares those values with the most recent flight release and uplinks data regarding any discrepancies.

- REL# OK/FOD OK - verification that the release and FOD are correct. FOD is considered valid if it equals or does not exceed the release fuel by more than 400 pounds.
- RELES# ERR - the downlinked release number does not match the most current release. The current release/amendment number will be listed. Contact Station Ops or Dispatch and obtain the current release.

  Note: If Dispatch issues a new or amended release after the preflight report has been sent and a response received, an automatic update will be uplinked.
- CK FOD - the FOD does not match the release fuel parameters.

LOAD DATA Page

Description

The load data message is sent to the aircraft from load control after the flight has been closed out. It may not appear until after leaving the gate.

If load data has not been received in a reasonable amount of time after leaving the gate, send a LOAD REQ (LSK 6L). If the load data is finalized and available in the data base, it will be sent immediately. If it is not completed, a message will alert the load agent that you have requested the data. Load Control may uplink a message identifying the reason for the delay. When the data is complete, it will be sent to the aircraft automatically. If a response has not been received within one minute of sending the request, and time is a factor, contact Load Control via gate radio.

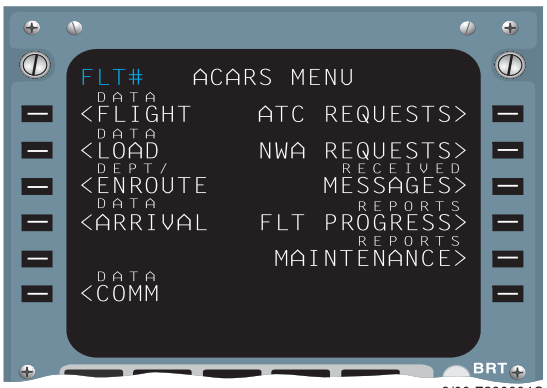
If a subsequent correction is issued after the first weight message is sent, the crew is alerted by a pulsating ACARS MSG on the upper ECAM and a LOAD REVISION message on the MCDU scratchpad.

Note: Load information is only removed or deleted after landing or if new load information is uplinked to the aircraft.

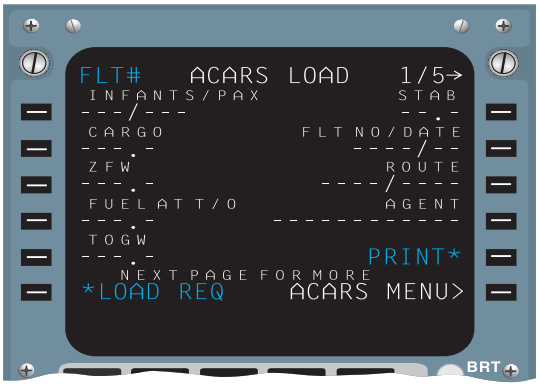
Note: The LOAD DATA page and all of its functions are currently not available.

Function

Pressing LSK 2L on the ACARS MENU displays the DATA LOAD 1/5 page.



8/00 F230004C



8/00 F230194C

INFANTS/PAX

Number of infants on board and the number of child/adult passengers. Total head count is the sum of infants, passengers, and all crewmembers indicated in the remarks section.

CARGO

Total cargo weight (e.g., 6,500 lbs = 6.5).

ZFW

This is the zero fuel weight (e.g., 115,000 lbs = 115.0).

FUEL AT T/O

Total fuel on board at takeoff (release minus planned taxi fuel) (e.g., 20,000 lbs = 20.0).

TOGW

This is the predicted takeoff gross weight (e.g., 105,240 lbs = 105.2).

LOAD DATA Page (continued)

*** LOAD REQ**	Load information is automatically uplinked to the aircraft from load control. Load data is printed automatically each time a new weight tab is received. This prompt permits the crew to request their load data from load control in the event of a delay in receipt after pushback.
STAB	Stabilizer trim setting in units. The sign is displayed as "-" for nose up, or "+" for nose down.
FLT NO/DATE	Flight number and originating UTC date. This is used to confirm that FPS agrees with information entered on the FLIGHT DATA page and the data is for the specified flight.
ROUTE	Display of the departure and destination stations. It is used to confirm that the proper information is entered on the FLIGHT DATA page or that the data is for the specified flight.
AGENT	Name of the load agent working the flight.
PRINT *	The weight data is printed automatically without request as soon as the weight data message is uplinked to the aircraft. Selecting the PRINT* prompt causes a second weight data message to be printed.
ACARS MENU or AOC MENU (A319)	On most ACARS pages, LSK 6R is reserved for the ACARS MENU> or AOC MENU prompt. Selecting this prompt returns the user to the ACARS main menu.

DEPT/ENROUTE Page

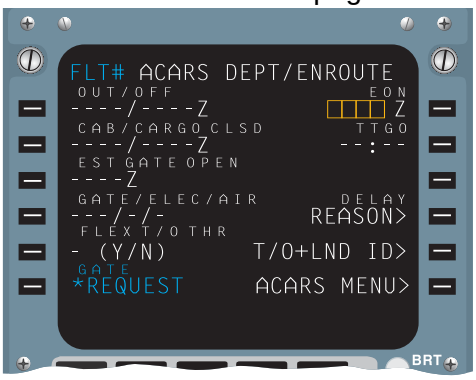
Description

This page combines departure information with other information that may be used while enroute. The data continues to appear on this page throughout the flight.

Function

Pressing LSK 3L on the ACARS MENU displays the DEPT/ENROUTE page.

8/00 F230004C



8/00 F230195C

OUT/OFF

The OUT/OFF times are automatically downlinked as part of the departure report. These times are automatically generated as they occur. The OUT time is the time the aircraft first moves for the purpose of flight. The OFF time is recorded when the aircraft becomes airborne.

CAB/CARGO

These are the times of the last cabin and cargo door closures. These times assists in later analysis of delays.

EST GATE OPEN

This field is for future growth.

GATE/ELEC/ AIR

This field displays the expected gate for arrival when the crew selects the gate request prompt at 6L. The ELEC and AIR fields are for future growth.

FLEX T/O THR

This field is for future growth.

GATE *REQUEST

Selecting this prompt downlinks a message to request the arrival gate. This is where the crew should make their request for a gate prior to the in-range report.

Note: Currently not available.

EON

The estimated ON time or LANDING time is automatically calculated after takeoff by adding the ETE entered on the FLIGHT DATA page to the OFF time.

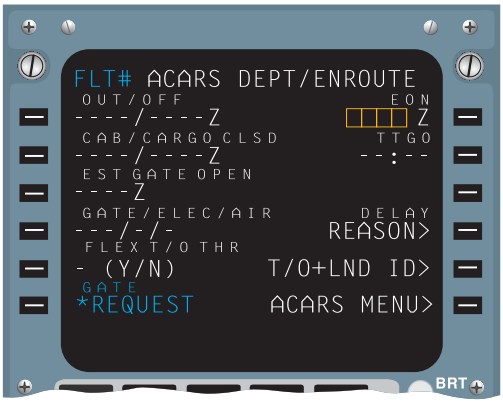
TTGO

Time to go (TTGO) refers to the amount of time remaining before the EON. This display stops when it reaches 0 but automatically resets if the EON is updated.

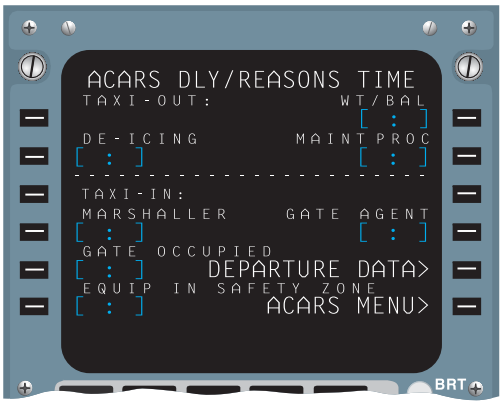
DEPT/ENROUTE Page (continued)

DELAY REASON

Selecting DELAY REASON, accesses the ACARS DELAY/REASONS TIME page. This page can be accessed from many menus, with TAXI-OUT and TAXI-IN delay reasons entered. It should be completed during a low workload phase of flight. Insert the minutes that correspond to the delay reason.



8/00 F230195C



8/00 F230207C

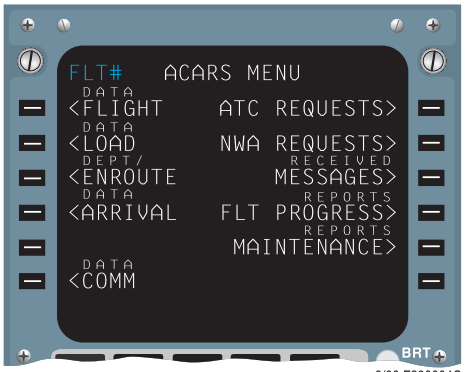
ARRIVAL DATA Page

Description

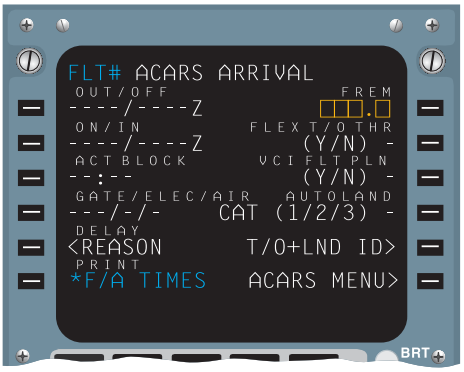
If in the ACARS system, the ARRIVAL DATA page automatically appears on the screen 30 seconds after the ON event is recorded. An IN event is the time the aircraft stops moving at the termination of flight, and is automatically generated by setting the parking brake after arrival. The arrival data automatically downlinks seven minutes after the IN event. The IN message is not transmitted until the IN event occurs, the FUEL RM field is loaded, and the T/O and LAND IDs are loaded. However, if these fields are not completed in seven minutes after the IN event occurs, the message is transmitted with these fields blank.

Function

Pressing LSK 4L on the ACARS MENU displays the ARRIVAL DATA 1/2 page. Use this page to enter arrival data prior to the automatic sending of the IN message.



8/00 F230004C



8/00 F230196C

OUT/OFF, ON/IN

For convenience, all four times are displayed on one page. IN time reflects when the parking brake was set before a cabin door was opened. This means that if the parking brake was set before arriving at the gate (e.g., awaiting a gate in the penalty box), and the parking brake is not set when parked at the gate, ACARS records and sends the earlier time.

ON time is generated when the wheels touch the ground during landing.

ACT BLOCK

Actual block time calculated by ACARS as the IN time minus the OUT time.

GATE/ELEC/ AIR

This field displays the expected gate for arrival if the crew selects the gate request prompt on the DEPT/ENROUTE page.

DELAY REASON Refer to DEPT/ENROUTE page description.

PRINT *F/A Selecting this prompt prints the flight attendant times.

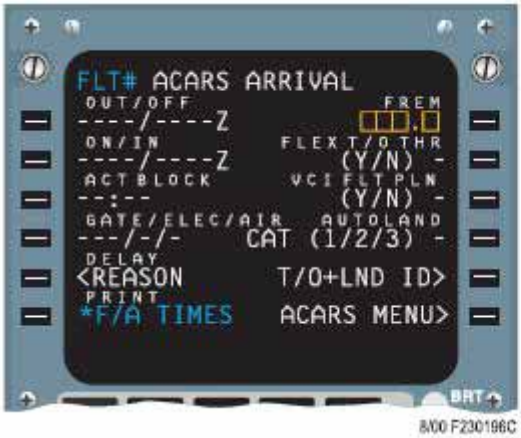
FREM Enter the fuel on-board after arrival at the gate (e.g., 6,000 lbs = 6.0)>.

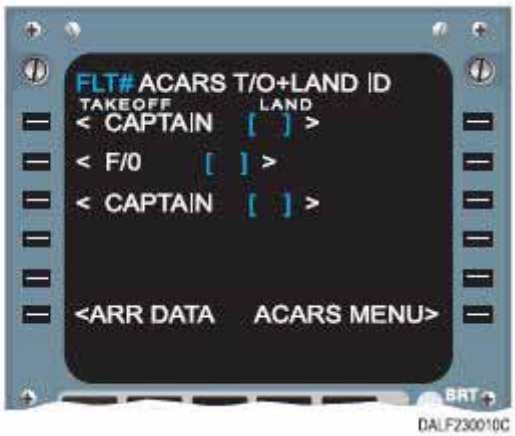
FLEX T/O THR This field is for future growth.

VCI FLT PLN This field is for future growth.

AUTOLAND If an autoland was accomplished, enter the weather conditions. Enter 1, 2 or 3 as appropriate.

T/O+LND ID Selecting this prompt displays the following ACARS page. This information is used by flight records to determine takeoff and landing currency. To ensure both pilots receive credit for an autoland, a free text entry must be made.





ARRIVAL DATA Page (continued)

T/O ID

Selecting the appropriate LSK identifies the pilot making the takeoff.

LAND ID

Selecting the appropriate LSK identifies the pilot making the landing. The ID information is preloaded from the CAPT ID and F/O ID lines on the FLIGHT DATA page. Press the appropriate LSK for takeoff and landing. The takeoff and landing fields then loads automatically to page one of the ARRIVAL DATA page.

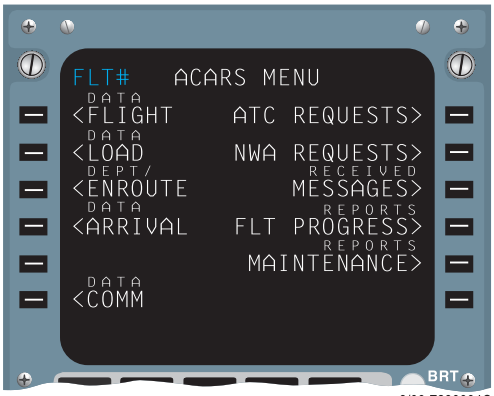
COMM-DATA Page (A320 Only)

Description

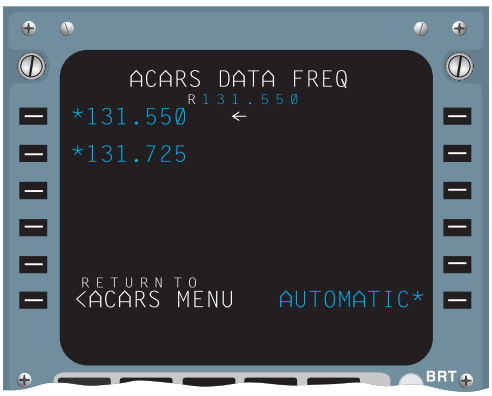
The COMM-DATA page displays the tuned VHF frequency. ACARS is normally tuned to a base frequency of 131.550 for domestic operation.

Function

The COMM-DATA page is available by pressing LSK 6L on the ACARS MENU.



8/00 F230004C



4/01 F230017C

DATA FREQ

The current frequency is displayed below the page title preceded by a letter. This letter characterizes how the current frequency is selected. Generally, ACARS automatically scans, selects, and locks on one of the many network frequencies. The crew can manually select either 131.550 or 131.725 by selecting the appropriate LSK.

AUTOMATIC*

Selecting AUTOMATIC (LSK 6R) allows the ACARS unit to resume its normal automatic mode. ACARS scans the network frequencies, selects and locks onto the appropriate frequency.

RMP Selected Voice Comm

The RMP can be used to select voice communications on VHF 3. Inserting the desired frequency into the RMP standby window and pressing the transfer key transfers the desired frequency into the active window and move ACARS to the standby window. To return to ACARS data mode use the RMP transfer key to transfer the word ACARS back to the active window. Expect a short delay while the system shifts between modes and clears the applicable messages.

Note: All ACARS data capabilities are inoperative in VOICE MODE. Any downlink messages that have not yet been sent are stored in a queue and sent when ACARS is returned to data mode.

ATSU (A-319 Only)

ATSU equipped aircraft contain a different COMM page for tuning ACARS.

Caution: *Although de-tuning the page is easy, retuning is extremely difficult, therefore, this page is only to be used by maintenance.*

ATC REQUESTS Page

Description

This menu provides commonly used ATC requests by selecting the corresponding LSK.

Function

The ATC REQUEST MENU page is selected by pressing LSK 1R on the ACARS MENU.

8/00 F230004C

8/00 F230197C

CLEARANCE PRE-DEPARTURE

Pressing LSK 1L selects the ACARS PDC REQUEST page. PREDEPARTURE CLEARANCE requests an ATC predeparture IFR clearance at major US airports noted in Jeppesen -7 pages. ACARS PDC clearances should be requested 15 to 30 minutes prior to scheduled departure time. Do not delay departure waiting for an ACARS PDC clearance. If necessary, contact clearance delivery to obtain a clearance.

DEST STN

The indicated station reflects the destination station listed on the FLIGHT DATA page. Use the 4-letter ICAO code (e.g., KATL, KDTW) for this field. Pressing LSK 5L downlinks a request for the ATC clearance. The clearance message appears on the RECEIVED MESSAGES MENU when it becomes available.

8/00 F230013C

ATC REQUESTS Page (continued)

PDC Message

ACARS PDC messages are digital copies of the “flight strips” ATC uses to control flights. ATC sends the message to Delta’s FPS computer about 30 minutes prior to scheduled departure time. Delta can not alter or determine the content of the message.

The following points apply to ACARS PDC clearances:

- clearance received verbally from an ATC controller over the radio always takes priority over an ACARS PDC clearance, even if an ACARS PDC clearance is received after receiving the verbal clearance,
- the appropriate ATC controller is the final clearance authority and must resolve any questions about a clearance,
- review every page of the ACARS PDC message. ACARS departure clearances are often more than two pages in length. A page number identification will appear at the top right corner of each page showing the current page and total number of pages in the message. The note -END- will appear as the last item of the message,
- to avoid confusion, delete old PDC messages that may remain in the ACARS Received Message log from previous flights, and
- Verify that the ACARS PDC message specifies the correct flight number, date, city pair and aircraft type before accepting it as your departure clearance.

The PDC clearance appears on the RECEIVED MESSAGES MENU.

```
.N3XXUS KPDX ---------- 14JAN15 2030Z
PDC 440 PDX SEA
PDC 440 PDX SEA
***DATE/TIME OF PDC RECEIPT: 12JAN 2030Z

**** PREDEPARTURE CLEARANCE ****
VERIFY PDC VALID TIME W/ATC IF MORE
THAN 90 MINUTES PAST SKED DEP TIME

DAL440 DEPARTING KPDX TRANSPONDER 1413
SKED DEP TIME 2100    EQUIP A320/Q
FILED FLT LEVEL 190
       ROUTING
**************************************************
   -CLEARED AS FILED-
KPDX LAVAA6  YKM  CHINS9  KSEA
**************************************************
LAVAA#   DEPARTURE  YKM  TRANSITION
CLIMB  VIA  SID,  MAINTAIN  11000
DEPARTURE  FREQUENCY 124.23
```

ACARS PDC messages always begin with the title PDC Flt No/Date/Dept Station, followed by three main blocks of information: flight data, route of flight, and local ATC controller remarks.

ATC REQUESTS Page (continued)

Flight Data

The flight data includes:

- flight number, flight date (as shown on the release), and departure city,
- aircraft type,
- requested altitude,
- proposed departure time,
- Estimated Departure Clearance Time (EDCT) or “wheels up” time. An EDCT is only included when ATC delays are anticipated. Check with station operations or Dispatch prior to leaving the aircraft due to ACARS EDCT indication. Delta’s Operations Control Center (OCC) may have coordinated an earlier departure time that is not indicated on the PDC message, and
- transponder code.

Route of Flight

This section will be in one of two formats depending upon whether ATC has accepted the Delta flight plan “as filed” or has amended it.

Flight plan accepted as filed:

- CAF - (Cleared as Filed) - This indicates that ATC has made no changes to Delta’s filed flight plan. The cleared route of flight (which is also the filed route) follows this notation.

Flight plan is amended by ATC:

- ATC CLEARANCE - This line indicates that ATC has amended the filed route. The cleared route will always follow this notation. RV is the standard abbreviation for “radar vectors.” The words THEN AS FILED indicate that the ATC clearance joins the filed flight plan routing.
- FILED FLIGHT PLAN - When ATC amends the filed route, the PDC message will nearly always include at least some portion of the originally filed route of flight. The aircraft is not actually cleared to fly this route until after the point where it is joined by the route specified under ATC CLEARANCE.

The “@” symbol may appear in the route of flight section followed by remarks that are intended only for ATC controllers. These remarks are designed for the controller’s “flight strip” and cannot be removed from the copy that is sent to the flight deck via ACARS. They are not normally read in a verbal clearance.

ATC will not always display the entire route of flight on a departure clearance. In this case, the symbols “***” or “./.” (know as “truncation codes) are inserted after the displayed portion of the route, followed by the final destination. This equates to the statement “then as filed” in a verbal clearance.

ATC Controller Remarks

Local controllers add remarks to every PDC message to specify such things as departure frequencies and initial altitude assignments. These remarks follow no standard form or conventions and often vary greatly between airports.

ATC REQUESTS Page (continued)

"ATC Clearance" Responses

Seven messages may be sent to an aircraft in response to an ATC CLEARANCE request. Whenever the response instructs REQUEST DEPARTURE CLEARANCE ON VOICE the crew must contact clearance delivery on the applicable radio frequency to obtain a departure clearance.

- PDC (PREDEPARTURE CLEARANCE) - The PDC message will be sent to the aircraft when available.
- MULTIPLE PDC RECEIVED. REQUEST DEPARTURE CLEARANCE ON VOICE - More than one PDC has been received from ATC. If an ACARS clearance has already been received, it is suspect. Contact clearance delivery to obtain or verify your departure clearance.
- EQUIP TYPE MISMATCH. REQUEST DEPARTURE CLEARANCE ON VOICE - The equipment type on the PDC message from ATC did not match the equipment type indicated in Delta records. Contact clearance delivery.
- RELEASE AMENDED. RELS #02 AMEND #01 REQUEST DEPARTURE CLEARANCE ON VOICE - This message indicates that the route portion of the release for your flight has been changed since it was first filed with ATC. Check the release and amendment number with your flight papers and request a new release from Dispatch or station operations as required. In addition, the crew much contact clearance delivery.
- PDC NOT RECEIVED. STANDBY UNTIL ___ Z - The indicated time will be 15 minutes prior to departure. FPS will automatically send the PDC if it becomes available. If PDC is not received by the time indicated, contact clearance delivery to obtain departure clearance.
- PDC NOT AVAILABLE. REQUEST DEPARTURE CLEARANCE ON VOICE - Less than 15 minutes remain before the estimated time of departure (ETD); or ETD has already passed, and FPS still has no clearance available. Contact clearance delivery to obtain departure clearance.
- ___ NOT PDC STATION. REQUEST DEPARTURE CLEARANCE ON VOICE - Automated PDC is not available to Delta at the location indicated (departure station). Contact clearance delivery to obtain departure clearance.

ATC REQUESTS Page (continued)

CLEARANCE PUSHBACK

Pressing LSK 2L displays the CLEARANCE PUSHBACK page. Refer to applicable airport - 7 pages for specific operating instructions.

8/00 F230197C

11/00 F230014C

CLEARANCE TAXI

Pressing LSK 3L displays the CLEARANCE TAXI page. Refer to applicable airport - 7 pages for specific operating instructions.

8/00 F230197C

11/00 F230015C

ATC REQUESTS Page (continued)

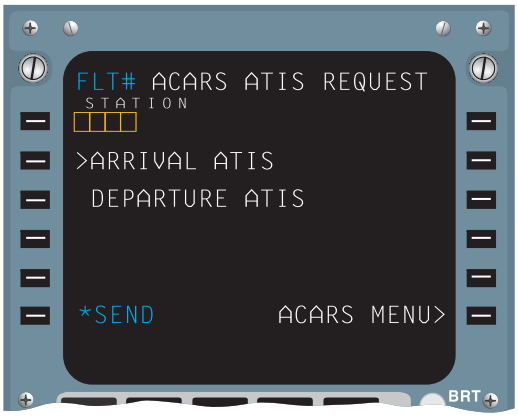
ATIS

Pressing LSK 4L displays the ATIS page. This page defaults to the departure station and the departure ATIS before takeoff. It automatically changes to the destination station and arrival ATIS after takeoff.

The crew can enter any desired station (use the four letter ICAO code) and manually select either departure or arrival ATIS at any time. Press the *SEND prompt to downlink the request. ATIS information prints when the *PRINT prompt is pressed.

The caret (>) indicates whether departure or arrival ATIS has been automatically or manually selected. After the desired ATIS is selected, the ATIS appears on the RECEIVED MESSAGES MENU when it becomes available.

8/00 F230197C



8/00 F230016C

NWA REQUEST Page

Description

This menu provides commonly used NWA requests by selecting the corresponding line.

Function

Pressing LSK 2R on the ACARS MENU displays the NWA REQUEST menu.

FREE TEXT 1/2

Pressing FREE TEXT on the NWA REQUEST menu (LSK 1L) or on the FLIGHT PROGRESS REPORTS MENU (LSK 5R) on the ACARS MAIN menu displays the following FREE TEXT page.

To address the text message, enter the appropriate address code in the scratchpad and then select LSK 1L. The message may be sent to more than one address at a time by placing a slash between the addresses. For example, a message can be sent to Dispatch and the destination station by entering A/B in the address field.

Once an address is selected, ACARS automatically displays page 2/2 allowing free text entry.

Response times will very depending upon where the message is sent. Messages addressed to “Dispatch” are routed directly to the Dispatcher’s CRT and should result in a timely response. Messages addressed to other ground locations are sent to printers and response time will vary depending upon manning and printer location.

NWA REQUEST Page (continued)

Free Text messages can be used to answer questions or acknowledge an uplink from ground personnel, however, their use should be limited as follows:

- MAINT CTRL - Free text messages are routed to Maintenance Control in Atlanta. This page should be used to report something other than a logbook write-up or to answer an uplink question from them. These messages are not routed to station line maintenance. For maintenance logbook write-ups use the ENROUTE MAINT WRITE-UP from the REPORTS MAINTENANCE page.
- DEST STATION - EON updates should be communicated via the FLT PROGRESS REPORTS page which automatically updates flight information in the FPS. A free text EON update requires a station agent to manually update the FPS.
- FLT TIMES OFFICE - use this address to communicate with the Flight Times office regarding flight times discrepancies.
- CREW SKDS - These messages should relate to the immediate scheduling requirements of flight crew members. For example, this message can be used to give scheduling advance notice that outbound flights could be delayed due to crew rest requirements. Normally, postflight telephone coordination of such events is required unless specific acknowledgement / resolution is uplinked from crew scheduling. Free Text messages should be used to bid or resolve long term scheduling problems.
- Meteorology/WX - Can be used for PIREPS that are best suited to a free text format. Normally, flight Dispatch should also be addressed on such messages.

FREE TEXT 2/2

Used for special requests such as aisle chairs, wheel chairs, security, traveler's aid, etc. Any combination of letters or numbers in free text format may be entered on this screen.

One full line of text is entered on the scratchpad line at a time, then transferred to the appropriate line above by pressing a LSK. On some aircraft, ACARS automatically enters the completed text line. To manually enter the text line, the left side LSK places the text on the line adjacent to the LSK. The right side LSK places the text immediately under data entered with the left side LSK. The sequence of data entry is 1L, 1R, 2L, 2R, etc.

The OVFY key operates as a space key. Up to 166 characters including spaces may be entered. The TEXT BUFFER FULL advisory is shown and the last scratchpad entry is erased if more than 166 characters are loaded on the FREE TEXT page.

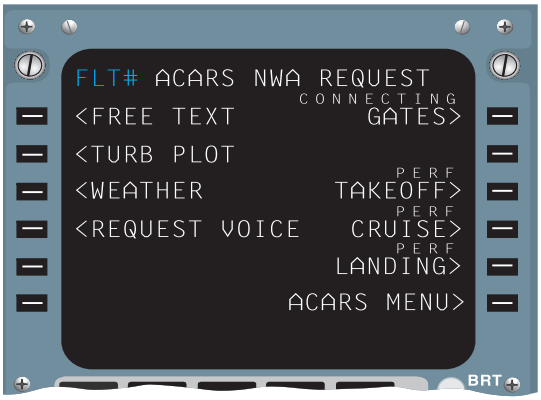
Pressing LSK 6L downlinks the free text message if at least one line of text has been entered. The text remains on this page until the message is acknowledged by the ground station, then the system returns to the ACARS MENU page.

NWA REQUEST Page (continued)

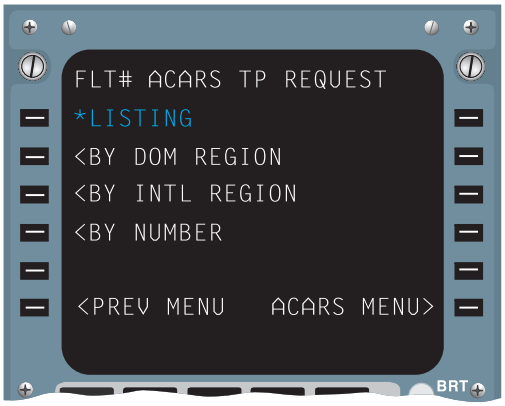
TURB PLOT

Pressing LSK 2L on the NWA REQUEST menu displays a TP REQUEST menu.

Full text of a specific TP may be obtained by selecting the TP region or number on the displayed page.



11/00 F230018C



11/00 F230019C

***Listing**

Selecting LSK 1 uplinks the list of all active turbulence plots (TPs).

BY DOM REGION

Selecting LSK 2L provides a listing of all active TPs in each domestic region.

BY INTL REGION

Selecting LSK 3L provides a listing all active TPs in each international region.

BY NUMBER

Select LSK 4L to display the TP NUMBER page. If the number of a specific TP is known, this selection requests uplink of that TP.

NWA REQUEST Page (continued)

WEATHER

Pressing LSK 3L displays the hourly WEATHER REQUEST page. Weather requests may be entered for as many as three stations by using either three or four letter city codes. Weather for the location entered is requested by pressing LSK 4L or 5L. To display the weather message, select the RECEIVED MESSAGES page from the ACARS MENU.

The default station is the destination. To request weather for a different station, enter the new city code into the scratchpad and press LSK 1L. For international stations, four letter ICAO codes must be used.

11/00 F230018C

11/00 F230023C

REQUEST VOICE

Pressing LSK 4L on the NWA REQUEST menu displays the REQUEST VOICE page.

11/00 F230018C

11/00 F230025C

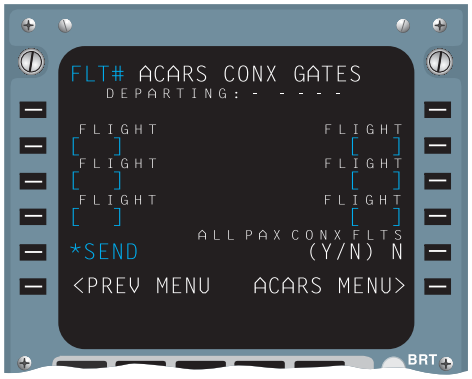
The message typed on the REQUEST VOICE page, along with any added remarks, is sent to the Dispatcher responsible for the flight. A voice go ahead advisory and a free text message from Dispatch is sent in response to this downlink. The message contains a preferred VHF frequency for conducting a voice radio conversation with the Dispatcher based on the current aircraft location.

NWA REQUEST Page (continued)

CONNECTING GATES

Pressing LSK 1R displays the CONX GATES page. This page allows a request for connecting gate information at any point in flight (as apposed to the identical feature located on the in-range page which should only used 20-30 minutes before landing).The connecting gate information for up to six flights may be entered. Pressing the *SEND prompt at LSK 5L transmits the request.

11/00 F230018C



4/01 F230026C

T/O PERF

See the MGL section (5.995) in the Volume I.

CRUISE PERF

This field is for future growth.

LDG PERF

See the MGL section (5.995) in the Volume I.

RECEIVED MESSAGES Page

Description

This page displays all ACARS received messages.

Function

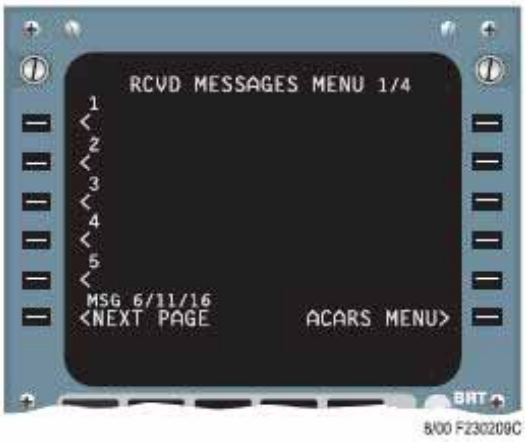
Pressing LSK 3R on the ACARS MENU displays the RECEIVED MESSAGES page.

When a message is uplinked to the aircraft, two indications occur on the flight deck:

- all received messages are white or blue (amber when called from dispatcher),
- ACARS MSG or ACARS CALL pulses in green on the memo display of the upper ECAM, and
- the MESSAGE WAITING, LOAD REVISION, GATE REVISION, or VOICE GO AHEAD advisory appears on the MCDU scratchpad.

These indications do not interrupt the use of the system but serve to advise the crew that a message is present for review.

Multiple Messages



Messages Cleared

RECEIVED MESSAGES Page (continued)

Message Que/ Interpretation

The first line of every uplinked message to the aircraft is displayed on this page, beginning with the newest and continuing in reverse chronological order to the oldest.

Up to 20 messages can be stored in the system's memory. When the memory capacity of the unit is full, the oldest message is automatically deleted as additional messages are received. The crew should manually delete old or unnecessary messages at the end of a flight to leave a clean RCVD MESSAGES MENU for the next flight.

When messages are replaced, the remaining messages are automatically renumbered.

To Display A Newly Received Message

From the ACARS MENU page, press the LSK 3R for RECEIVED MESSAGES. The new message is then automatically displayed.

To Display A Message For Review

From the ACARS MENU page, press the LSK 3R for RECEIVED MESSAGES. From the RECEIVED MESSAGES page, press the LSK for the message to be reviewed. Pages 2 through 4 can be accessed with the NEXT PAGE function key.

To Erase A Message From Memory

Once a message is erased, it cannot be retrieved. From the RCVD MESSAGES page, select the corresponding LSK and press the CLR key.

REPORTS FLT PROGRESS Page

Description

When REPORTS FLT PROGRESS is selected from ACARS MENU, another menu appears on the screen to select commonly used reports. The ACARS REPORTS menu displayed depends on the phase of flight (taxi out, enroute, taxi in). In each phase of flight, the ACARS system allows for a Free Text Message or a Pink Sheet report to be sent.

Function

Select ACARS MENU LSK 4R for REPORTS FLT PROGRESS.

8/00 F230004C

8/00 F230037C

11/00 F230038C

11/00 F230039C

ACARS REPRORTS TAXI OUT

During the taxi out phase of flight, the ACARS REPORTS TAXI OUT menu offers four reports.

FREE TEXT

Refer to the FREE TEXT description in this section (23.15).

REPORTS FLT PROGRESS Page (continued)

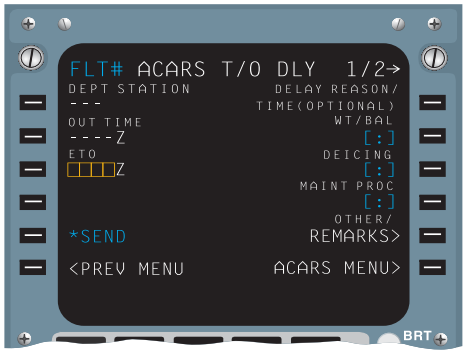
PINK SHEET

A PINK SHEET submitted through ACARS is downloaded directly into the pinksheet database for tracking and request for action. When downloaded, the employee number appears automatically. The FREE TEXT page appears automatically after entry of addresses.

TAKEOFF DELAY (ETO)

The ACARS TAKEOFF DELAY (ETO) message should be sent anytime a taxi out time of greater than 10 minutes is encountered. It is routed to the destination station and Dispatch. Enter the estimated takeoff time (ETO) and a reason for the delay and/or select OTHER REMARKS to explain the delay.

8/00 F230037C



8/00 F230211C

If taxi-out time has exceeded the scheduled taxi time by ten minutes without any update by the flight crew, the ETA alert message SEND DLY RPT + PAX PA will be displayed in the scratchpad of the MCDU. If time and workload permit, flight crews should respond by sending the TAKEOFF DELAY report and consider updating the passengers via a PA. To minimize distraction during taxi operations, responses to ACARS alert messages should be made while the aircraft is stationary.

DEPT STN

Automatically transfers from the DATA FLIGHT page.

OUT TIME

Automatically transfers from the DEPT/ENROUTE page.

ETO

Enter Estimated Time Off (UTC).

REPORTS FLT PROGRESS Page (continued)

DELAY REASON/TIME

Enter number of minutes attributed to, if desired, or use remarks to identify other delay reasons if time permits.

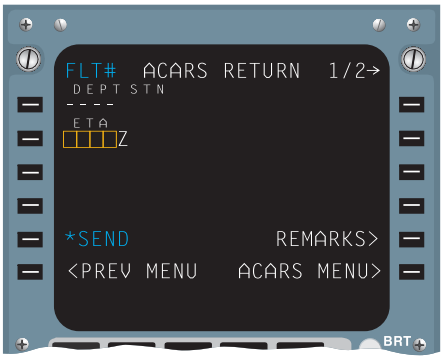
WT/BAL, DE-ICING, MAINT PROC, and REMARKS

Enter number of minutes attributed to, if desired, or use remarks to identify other delay reasons if time permits.

RETURN

Returns to the departure station gate, either before or after takeoff, should be sent by entering the estimated time arrival (ETA) and any remarks if needed. Sending the report resets the ACARS arrival station and allows the subsequent IN time to register correctly.

8/00 F230037C



8/00 F230040C

Note: Normally, returns are verbally coordinated with Dispatch/station personnel. However, RETURN allows for written communication if direct voice communications cannot be easily established.

DEPT STN

Automatically transfers from DATA FLIGHT page to this position.

ETA

Enter Estimated Time Arrival for return to departure station.

REMARKS

If time permits, enter the reason for the return.

FLIGHT PROGRESS REPORTS Page

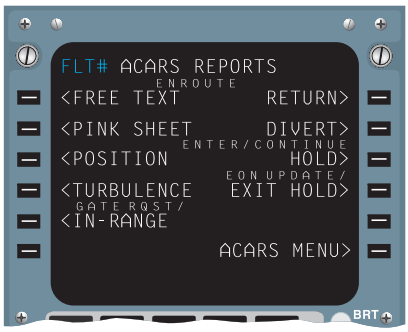
ACARS REPORTS ENROUTE

During the enroute phase of flight, the ACARS REPORTS ENROUTE menu offers nine reports. In each phase of flight, the ACARS system allows for a Free Text Message or a Pink Sheet report to be sent. These reports are described in the ACARS REPORT TAXI OUT.

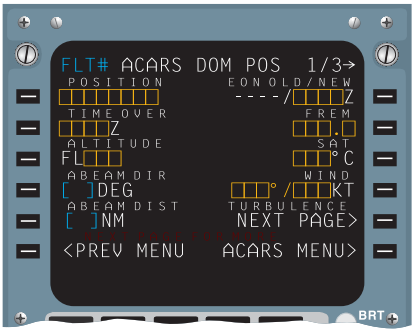
POSITION

When airborne, pressing LSK 3L displays the DOMESTIC POSITION REPORT page. Position Reports are automatically sent to Dispatch and meteorology.

Note: ACARS downlinked position reports are for company purposes only, not ATC.



11/00 F230038C



8/00F230048C

POSITION

Enter the current position.

TIME OVER

Enter the time over current position.

ALTITUDE

Altitude/flight level (normally automatic).

ABEAM DIR
ABEAM DIST

This field is an optional entry for a radial and number of nautical miles describing how far the aircraft is from the waypoint entered in the POSITION field above. If passing over a named waypoint, no abeam information needs to be entered.

EON OLD/NEW

EON automatically transfers from the DEPARTURE DATA page to this line. This entry should be updated through the ENROUTE DELAY report page whenever the EON is revised.

FREM

Enter fuel remaining.

SAT

Static air temperature (normally automatic).

WIND

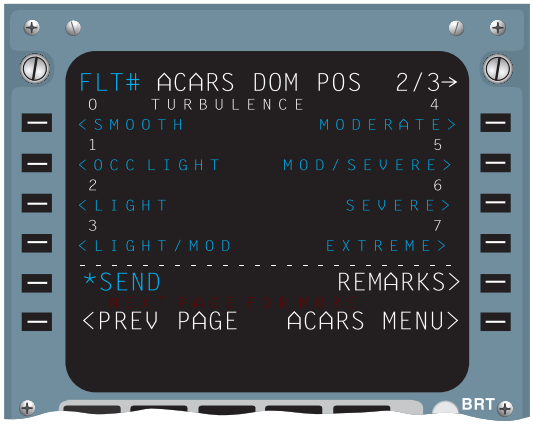
Enter the wind direction and speed.

FLIGHT PROGRESS REPORTS Page (continued)

TURBULENCE NEXT PAGE

Pressing TURBULENCE NEXT PAGE> (LSK 5R) changes the display to the DOMESTIC POSITION menu page 2/3.

ACARS DOMESTIC POSITION TURBULENCE



8/00 F230049C

8/00 F230050C

On page two, selecting the appropriate LSK for the degree of turbulence being experienced causes the appropriate codes to be downlinked with the position report. If no LSK is selected the default code for smooth is sent.

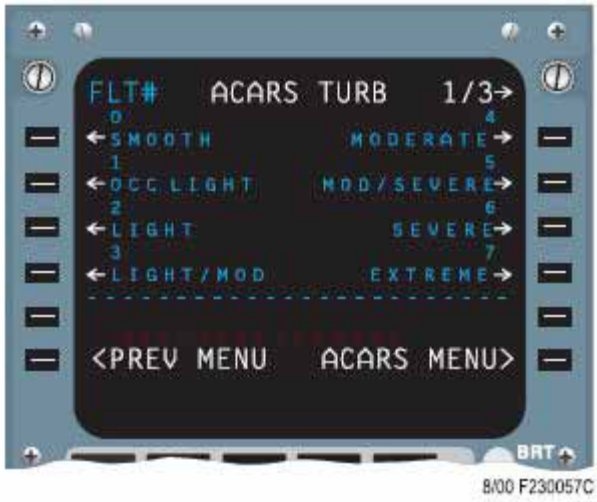
On page three, any combination of letters and numbers in free text may be entered via the scratchpad, and using the LSKs to enter the text in a field.

FLIGHT PROGRESS REPORTS Page (continued)

TURBULENCE

Pressing the LSK 4L on the ACARS REPORTS ENROUTE menu displays the ACARS TURB page. This report is routed to Dispatch and meteorology. It can be used to report turbulence, or the lack thereof in an area forecasted to have turbulence.

11/00 F230038C



8/00 F230057C

8/00 F230058C

ACARS TURB 1/3

On page one, selecting the appropriate LSK for the degree of turbulence being experienced causes the appropriate codes to be downlinked with the position report. If no LSK is selected the default code for smooth is sent.

ACARS TURB 2/3

Enter the flight levels at which turbulence was experienced. If the turbulence was limited to one altitude, enter that single flight level. Enter the position where turbulence was experienced, and enter the flight level at which a better ride was flown.

ACARS TURB 3/3

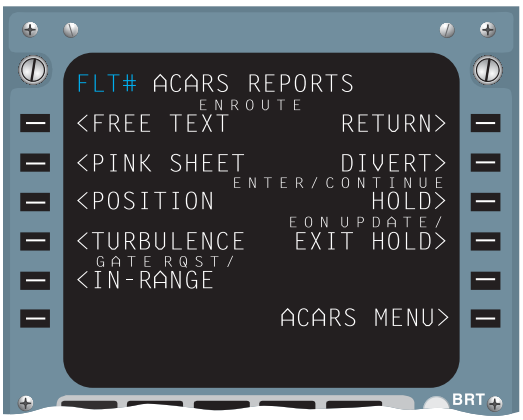
Remarks can be entered on ACARS TURB page 3/3.

FLIGHT PROGRESS REPORTS Page (continued)

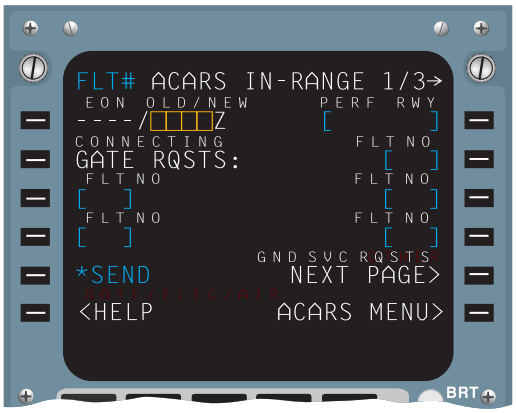
IN-RANGE

Pressing LSK 5L on the ACARS REPORTS ENROUTE menu displays the GATE RQSTS/IN-RANGE page. This report is essentially an EON “confidence check” for stations; it is used to confirm connection hold, gate availability, and other operational decisions. Please do not enter remarks unless needed. Complete this report approximately 20-30 minutes before arrival, after the type of approach or other factors affecting the EON are known.

FPS responds to the In-Range Report with the arrival gate, the aircraft's next departure time (for shut down planning), “through flight” change of aircraft (if applicable), and requested connecting flight outbound gate number and ETD in local time.



11/00 F230038C



8/00 F230051C

EON OLD/NEW

Estimated On Time OLD/NEW. A new entry is required (even if it is the same as the old time), before sending this message (LSK 1L).

CONNECTING GATES RQSTS

The FLT NO fields allow the crew to enter the flight numbers of connecting flights for which gate and departure time information is desired.

PERF RWY

Enter the expected landing runway to request landing performance information. Refer to the MGL section, (5.995) of AOM Volume I for more information. If a runway is entered into PERF Rwy (1R) landing MGL data is uplinked to the aircraft.

Note: This selection assumes default environmental conditions. If overrides are required, use the LDG PERF REQ page.

Note: This feature is currently not available.

FLIGHT PROGRESS REPORTS Page (continued)

GND SVC RQSTS NEXT PAGE

Selecting LSK 5R displays ACARS IN-RANGE page 2/3.

APU INOP

Used to confirm APU status. Entering “Y” alerts ground services that the APU is inoperative and external power is required; otherwise the field defaults to “N” indicating the APU is working.

WHEELCHAIRS

Enter the number of wheelchairs requested.

AISLE CHAIRS

Enter the number of aisle chairs requested.

UNACCOMP MINORS

Enter the number of unaccompanied minors on board.

ELEC CARTS

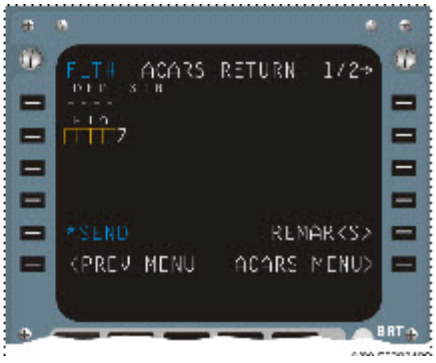
Enter the number of electric carts requested.

REMARKS NEXT PAGE

Selecting LSK 5R displays a free text page.

ACARS RETURN

Pressing the LSK 1R on the ACARS REPORTS ENROUTE menu displays the ACARS RETURN page. This page is used to report a return to the departure station after takeoff.



FLIGHT PROGRESS REPORTS Page (continued)

DEPT STN This data automatically transfers from the FLIGHT DATA page.

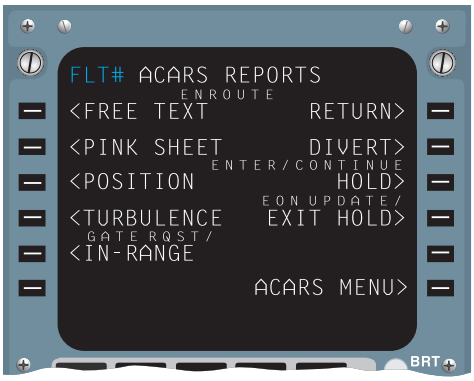
ETA Enter the ETA for the return to departure station.

REMARKS Selecting LSK 5R displays free text remarks page (ACARS RETURN 2/2). Any combination of letters and numbers in free text may be entered via the scratchpad, and using the LSKs to enter the text in a field. Up to 166 characters may be entered.

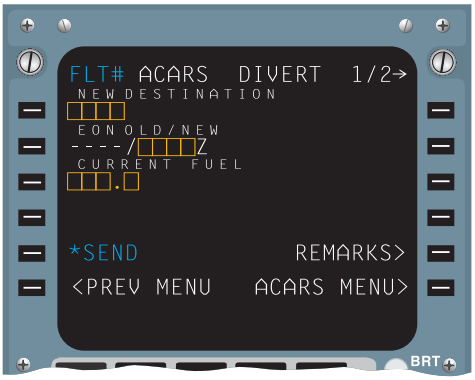
DIVERT Pressing LSK 2R on the ACARS REPORTS ENROUTE menu displays the ACARS DIVERT page.

This message is automatically routed to the controlling Dispatcher, the original destination station, and the new destination station. This page does not eliminate the need to coordinate with Flight Dispatch prior to diverting.

Use this page only when actually diverting. After coordinating diversion intentions with Dispatch, the ACARS diversion report must be sent to update ground computers and to update the ACARS destination station. This ensures that ACARS sends an arrival report to the correct station upon landing and helps coordinate ground activities.



11/00 F230038C



8/00 F230056C

NEW DESTINATION Enter the 4-letter ICAO code for the new destination.

EON OLD/NEW Enter estimated ON time (UTC time) for the new destination.

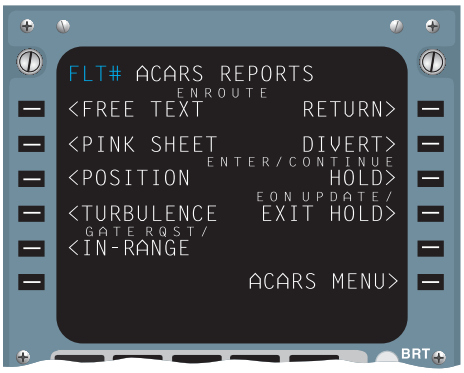
CURRENT FUEL Enter the current fuel on board.

REMARKS Selecting LSK 5R displays free text remarks page (ACARS DIVERT 2/2). Any combination of letters and numbers in free text may be entered via the scratchpad, and using the LSKs to enter the text in a field. Up to 136 characters may be entered.

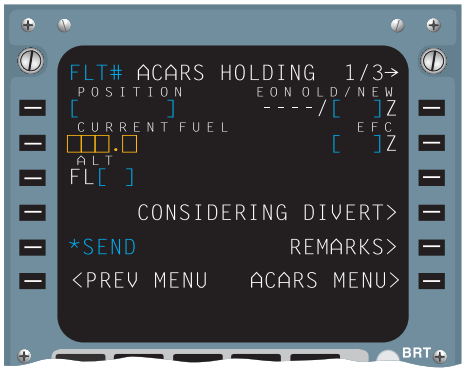
FLIGHT PROGRESS REPORTS Page (continued)

HOLD

Pressing LSK 3R on the ACARS REPORTS ENROUTE menu displays the ACARS HOLDING page. This page is routed to Dispatch and the destination station operations while automatically updating the EON/ETA in FPS and passenger display screens located throughout the system.



11/00 F230038C



11/00 F230053C

POSITION

Enter the holding fix (e.g., MSP, JUDAS).

CURRENT FUEL

Enter the current fuel on board.

ALT FL

Verify flight level.

EON OLD/NEW

Estimated ON time OLD/NEW. A new entry is required (even if it is the same as the old time), before sending this message (LSK 1R).

EFC

Enter the Expect Further Clearance time.

FLIGHT PROGRESS REPORTS Page (continued)

CONSIDERING DIVERT

Selecting LSK 4R displays ACARS HOLDING CONSIDERING DIVERT page. The CONSIDERING DIVERT information is optional and may be added if the situation warrants.

11/00 F230053C

11/00 F230054C

REMARKS

Selecting LSK 5R displays free text remarks page (ACARS HOLDING 3/3). Any combination of letters and numbers in free text may be entered via the scratchpad, and using the LSKs to enter the text in a field.

TO STATION

Enter the 4-letter ICAO code for the new destination.

AT FUEL

Enter the current fuel on board.

REMARKS

Selecting LSK 5R displays free text remarks page (ACARS HOLDING 3/3). Any combination of letters and numbers in free text may be entered via the scratchpad, and using the LSKs to enter the text in a field.

EXIT HOLD

Pressing LSK 4R on the ACARS REPORTS ENROUTE menu displays the ACARS EON page. This page provides a way to update the EON after exiting holding (if time permits).

11/00 F230038C

8/00 F230055C

FLIGHT PROGRESS REPORTS Page (continued)

EON OLD/NEW

Whenever the EON is revised on this page, and the message is sent, the new estimated landing time (EON) appears on all ACARS pages that display an EON. The revised EON is the only information that is required to send this message.

REMARKS

Selecting LSK 5R displays free text remarks page (ACARS EON 2/2). Any combination of letters and numbers in free text may be entered via the scratchpad, and using the LSKs to enter the text in a field.

ACARS REPORTS TAXI-IN

During the taxi-in phase of flight, the ACARS REPORTS TAXI-IN menu offers three reports. In each phase of flight, the ACARS system allows for a Free Text Message or a Pink Sheet report to be sent. These reports are described in the ACARS REPORT TAXI OUT.

11/00 F230039C

9/00 F230212C

TAXI IN DELAY (ETA)

During the Taxi-In phase, the TAXI-IN DELAY report is available for any significant delays encountered after landing. It is routed to the destination stations operations and the Dispatch.

If the taxi-in time exceeds the scheduled taxi time published on the flight plan by ten minutes withoout update, ACARS will display PLZ SEND GATE ETA RPT. If time and workload permit, repond by sending TAXI IN DELAY report. To minimze distractions during taxi operations, reponses to ACARS alert messages should be mde while the aircraft is stationary.

DEST STN

Automatically transfers from the DATA FLIGHT page.

ON TIME

Automatically transfers from the DEPT/ENROUTE page.

FLIGHT PROGRESS REPORTS Page (continued)

EGA	Enter the estimated gate arrival time (EGA) to update the ACARS system.
REMARKS	Use the Remarks section to describe the reason for the delay.

ACARS MAINT REPORTS Page

Description

Used to report engine and APU data, and logbook write up information to maintenance.

Function

Pressing LSK 5R on the ACARS menu to display the ACARS MAINT REPORTS menu.

ACARS WRITE-UP 1/2 Page

Pressing ENROUTE MAINT WRITE-UP (LSK 1L) on the ACARS MAINT REPORTS menu displays the ACARS WRITE-UP page. Four sets of logbook pages are provided and are saved for review during the flight.

Note: Complete the write-up in the aircraft's logbook prior to using this feature. This provides a reference for entering remarks, and assures consistency between the ACARS message and the logbook entry. Four write-ups may be stored.

DEST STN

The data in this field automatically transfers from the FLIGHT DATA.

CAPT ID

The data in this field automatically transfers from the FLIGHT DATA.

LOG NO

Enter the seven digit aircraft logbook page number used.

FAULT CODE

Enter this code if applicable.

ACARS MAINT REPORTS Page (continued)

BOXED MEL ITEM

Enter “Y” or “N.”

CLEANING / COSMETIC ITEM

Enter “Y” or “N.”

ACARS WRITE-UP 2/2 Page

To access ACARS WRITE-UP 2/2, press LSK 5R on the ACARS WRITE-UP 1/2 page. On page two, any combination of letters and numbers in free text may be entered via the scratchpad, and using the LSKs to enter the text in a field. Up to 166 characters may be entered. Enter the write-up exactly as it appears in the logbook.

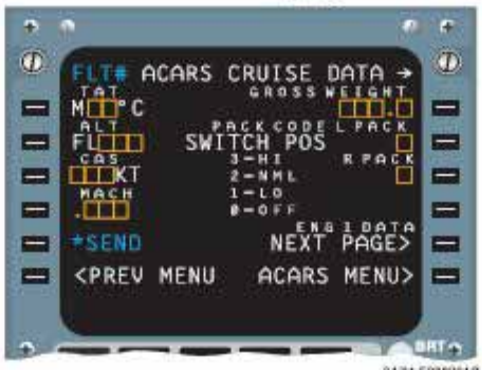
ENGINE DATA

Records engine cruise data for the ECM program.

Note: The asterisk appears next to the SEND prompt on the ENGINE DATA pages only after all data fields are loaded.

Function

Select LSK 2L on the ACARS MAINT REPORT menu to display ACARS CRUISE DATA page. This page is also accessed by pressing LSK 6L on the ACARS MAINT REPORT menu, then selecting 6L on the WRITE-UP GUIDELINES page.



TAT

Entered TAT. The field defaults with M for minus as the left most character. To enter a plus temperature, a P must precede the entry. For example, to enter +10°, type P10 into the scratchpad, and line select LSK 1L.

ALTITUDE

Flight Level Altitude in hundreds of feet (normally automatic).

CAS

Calibrated airspeed in knots (normally automatic).

MACH

Enter Mach number into the scratchpad and line selected into 4L.

ACARS MAINT REPORTS Page (continued)

GROSS WEIGHT

Enter present gross weight in thousands of pounds into the scratchpad and line selected into 1R.

L PACK flow, R PACK flow

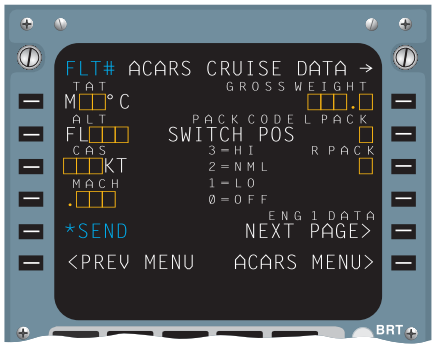
Enter the position of the PACK FLOW switch on the pilot's overhead panel (3-HI, 2-NORM, 1-LO) into the scratchpad and line selected into 2R and 3R.

ENGINE 1 DATA NEXT PAGE

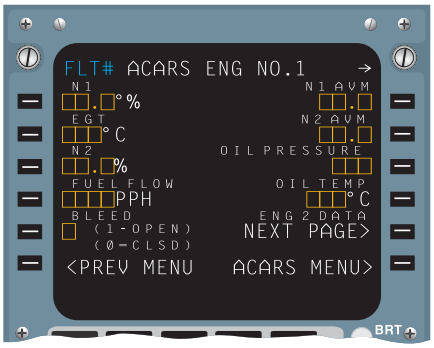
Selects ACARS engine 1 data page.

ACARS ENG - NO. 1 (NO. 2)

Selecting LSK 5R displays the ACARS ENG NO. 1 (NO. 2) page. Engine 1 and 2 pages are identical.



04/01 F230201C



11/00 F230067C

N_1

Enter N_1 rotor percent speed into the scratchpad and line selected into LSK 2L.

EGT

Enter engine EGT into the scratchpad and line selected into LSK 3L.

N_2

Enter N_2 rotor percent speed into the scratchpad and line selected into LSK 4L.

FUEL FLOW

Enter engine fuel flow in pounds per hour into the scratchpad and line selected into LSK 5L.

BLEED

Enter status of the engine bleed valve (with 1 representing open and 0 representing closed) into the scratchpad and line selected into LSK 3R.

AVM

Enter engine vibration (airborne vibration monitor) in units of amplitude into the scratchpad and line selected into the appropriate field.

OIL PRESSURE

Enter oil pressure in pounds (psi) into the scratchpad and line selected into LSK 3R.

ACARS MAINT REPORTS Page (continued)

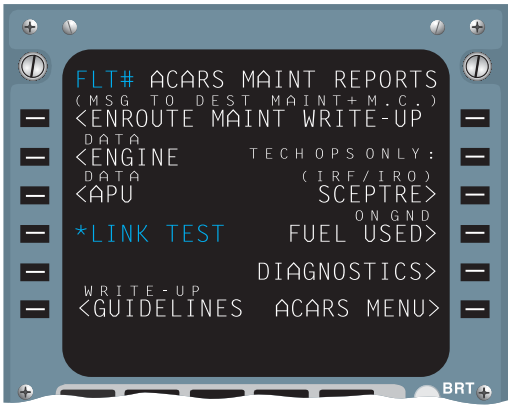
OIL TEMP

Enter oil temperature in degrees Celsius into the scratchpad and selected into LSK 4R.

ENG 2 DATA NEXT PAGE

Pressing LSK 5R displays the other ENGINE DATA page or the CRUISE page.

ACARS MAINT REPORTS (continued)



11/00 F230062C

DATA APU

Not used at this time.

SCEPTRE

Reserved for technical operations personnel.

ON GND FUEL USED

Reserved for technical operations personnel.

DIAGNOSTICS

Reserved for technical operations personnel.

WRITE-UP GUIDELINES

Provides online help regarding ACARS malfunctions.

E/WD Messages

Description

The ACARS system incorporates the memo display on the E/WD display to alert the crew of the ACARS status.

The following messages may be displayed:

Message	Meaning
ACARS ALERT / COMPANY ALERT (1 second buzzer)	Priority uplink message sent to the flight deck.
ACARS CALL	An ACARS message has been received that requests a voice communication on a specific radio frequency. The VOICE GO AHEAD advisory appears on ACARS.
ACARS MSG	An ACARS message has been received. The MESSAGE WAITING, LOAD REVISION, or GATE REVISION advisory appears on ACARS.
ACARS STBY	Indicates that ACARS is unable to communicate with the data-communication service provider. The NO COMMUNICATION advisory appears on ACARS.
VHF 3 VOICE	An ACARS message has been received that requests a voice communication on a specific radio frequency. The VOICE GO AHEAD advisory appears on ACARS.

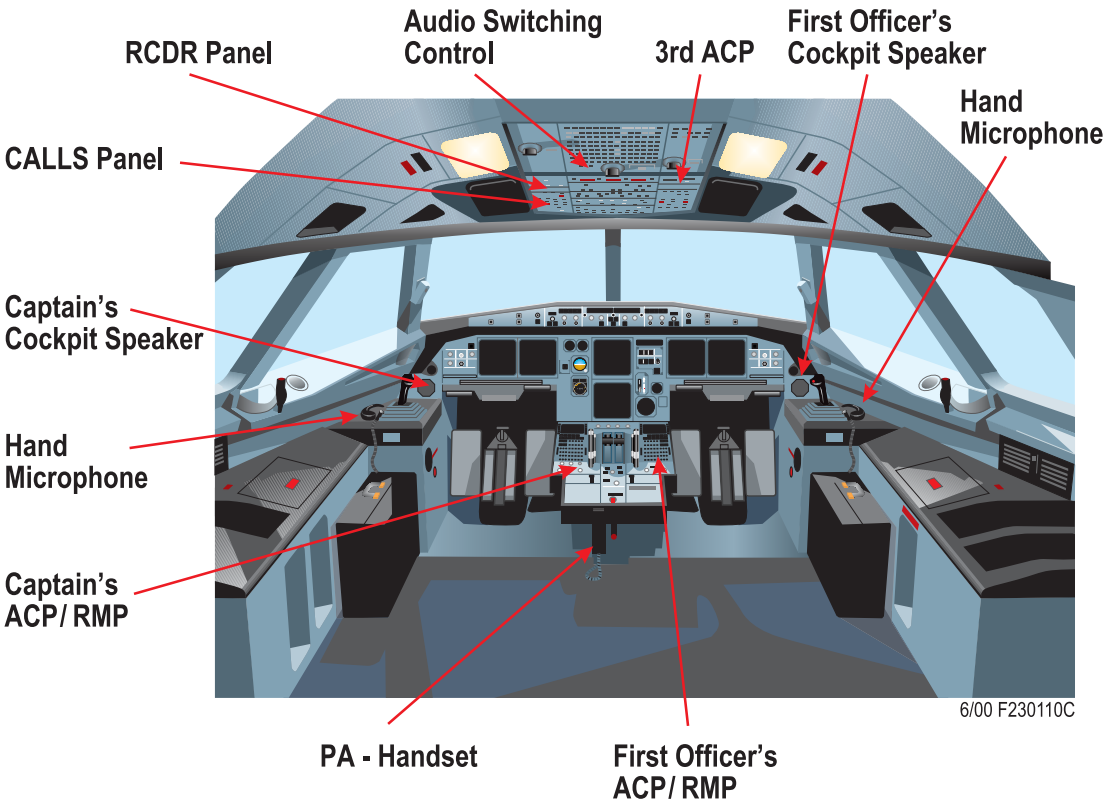
Intentionally Left Blank

Controls and Indicators

Location of Controls and Indicators

Location

Controls and indicators associated with the communication system are located throughout the cockpit as shown below.

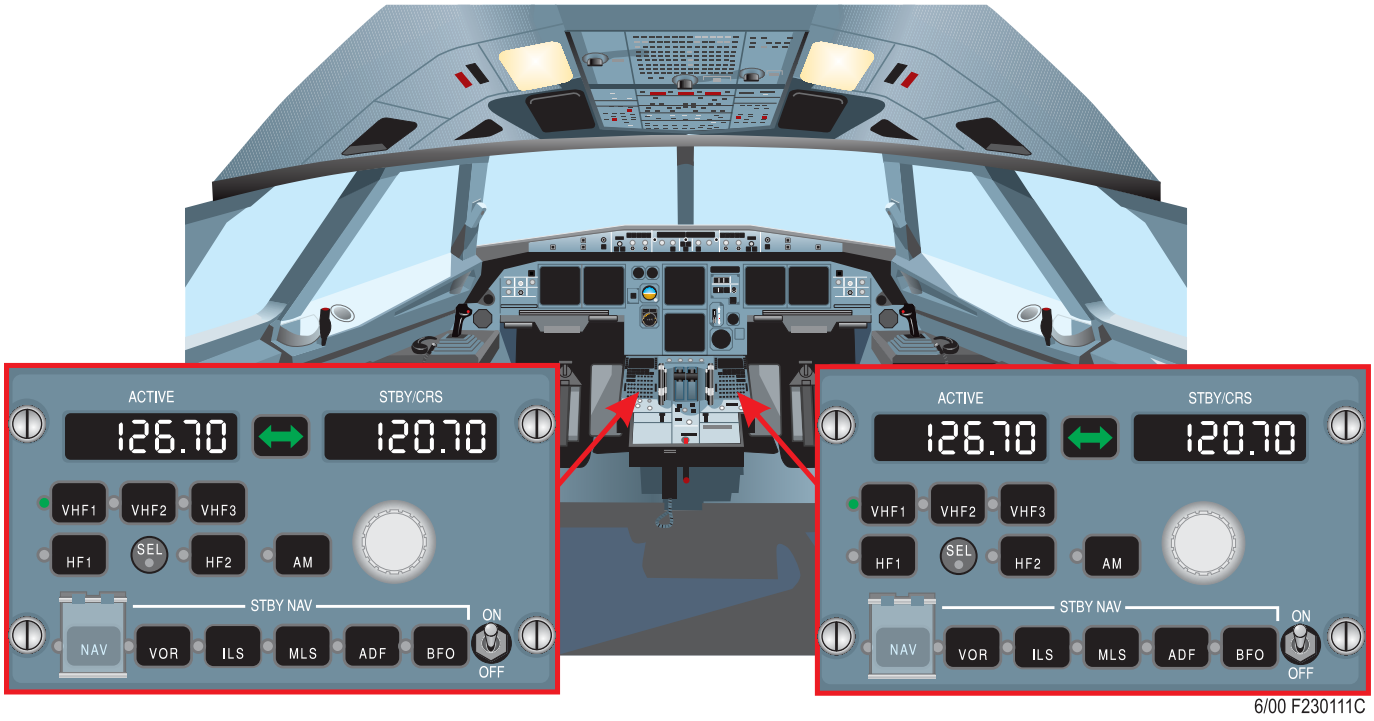


Radio Management Panel

Function

Two radio management panels (RMP), located on the pedestal, are used for VHF frequency control

.

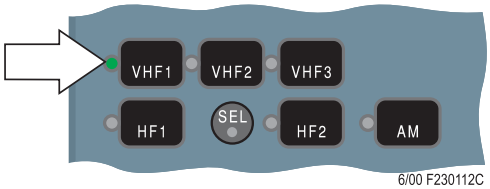


6/00 F230111C

Radio Communication Selection Keys

These keys allow the selection of the frequency on the VHF radio indicated by the number on the key.

When a key is pressed, a green light next to the key illuminates.



6/00 F230112C

ACTIVE Window

This window displays the active frequency of the selected radio.

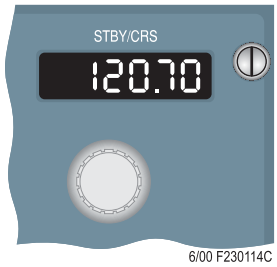
6/00 F230113C

Radio Management Panel (continued)

STBY/CRS Window

This window displays a standby frequency which can be made active by depressing the transfer key or changed by rotating the tuning knob.

If a course is displayed, the associated frequency is displayed in the ACTIVE window.

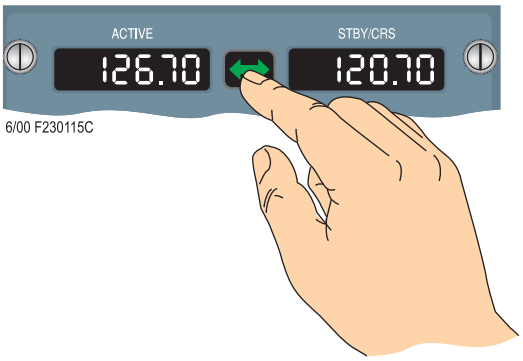


The captain's and first officer's STBY/CRS windows are independent and retain the last frequency selected on that RMP.

Transfer Key

When pressed, the active and standby frequencies are transferred. The selected radio is then tuned to the new active frequency.

In the standby navigation mode, the transfer key allows for the transfer of the navaid frequency to the ACTIVE window. The course is displayed in the STBY/CRS window.



Rotating Knob

Two concentric knobs allow preselection of frequencies for communication radios, standby navigation and to select the course for a VOR or ILS.

The desired frequency or course is viewed when tuned in the STBY/CRS window. The outer knob controls the most significant digits, the inner knob the least significant digits.

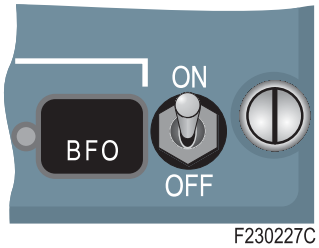
Radio Management Panel (continued)

ON/OFF Switch

Controls the power supply to the RMP.

BFO Key

This key is used to select the Beat Frequency Oscillator (BFO) function ON or OFF. The key illuminates when BFO is selected ON.



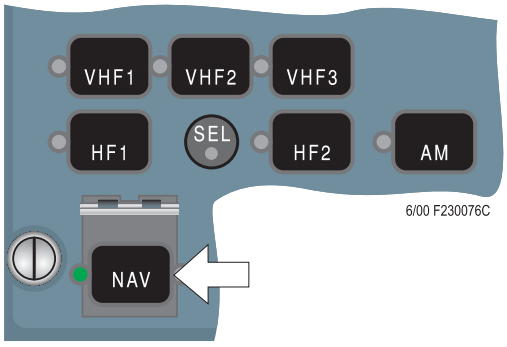
NAV Key

When the NAV key is pressed (guard lifted):

- the green light next to the key illuminates,
- the VOR, ILS, and ADF receivers are controlled by the RMP rather than the FMGC,
- either RMP controls ILS/DME receivers provided both RMPs are set to ON
- Standby (STBY) tuning has been selected,

Note: Nav radio control may be returned to the FMGC by pressing the NAV key again.

- The captain's RMP controls the VOR1 and ADF1 receivers, and



- the first officer's RMP controls the VOR2 receiver.

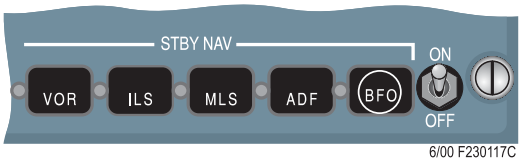
Note: If standby navigation tuning is due to a dual FMGC failure, both RMP NAV keys must be selected ON. If in the emergency electrical configuration, RMP1 NAV key must be selected ON.

Radio Management Panel (continued)

STBY NAV Keys

These keys allow for the selection of standby navigation radio tuning. When the appropriate ILS, VOR, or ADF key is pressed, and the NAV key is “ON,” the ACTIVE window displays the last tuned frequency. The light next to the selected key illuminates green.

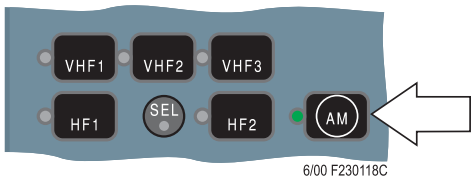
Additionally, when a key is selected, any previously selected STBY NAV key is deselected. (Only one STBY NAV key can be selected at a time.)



6/00 F230117C

AM Key

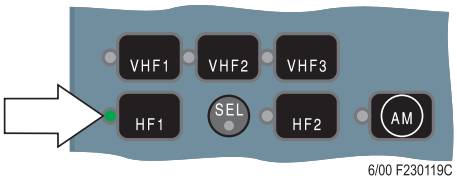
On A-320s with an HF radio installed, this key (when selected) provides amplitude modulation during HF communications. When selected off, only single sideband is available.



6/00 F230118C

HF1 Key & HF2 Key (as installed)

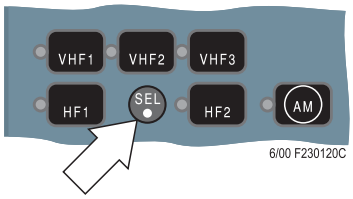
Pressing the HF1 key allows for frequency selection on aircraft equipped with an HF radio. HF2 allows for frequency selection on aircraft equipped with two HF radios.



6/00 F230119C

SEL Light

The SEL lights appear when particular VHF radio combinations are selected on the captain's and first officer’s RMPs. System design dedicates VHF1, VHF3, and HF1 (if installed) to the captains RMP. VHF2 is dedicated to the first officers RMP. Making radio selections other than this illuminates the SEL light. This should not inhibit either pilot from selecting and using any radio from either RMP. This light is of little significance to Delta operations.

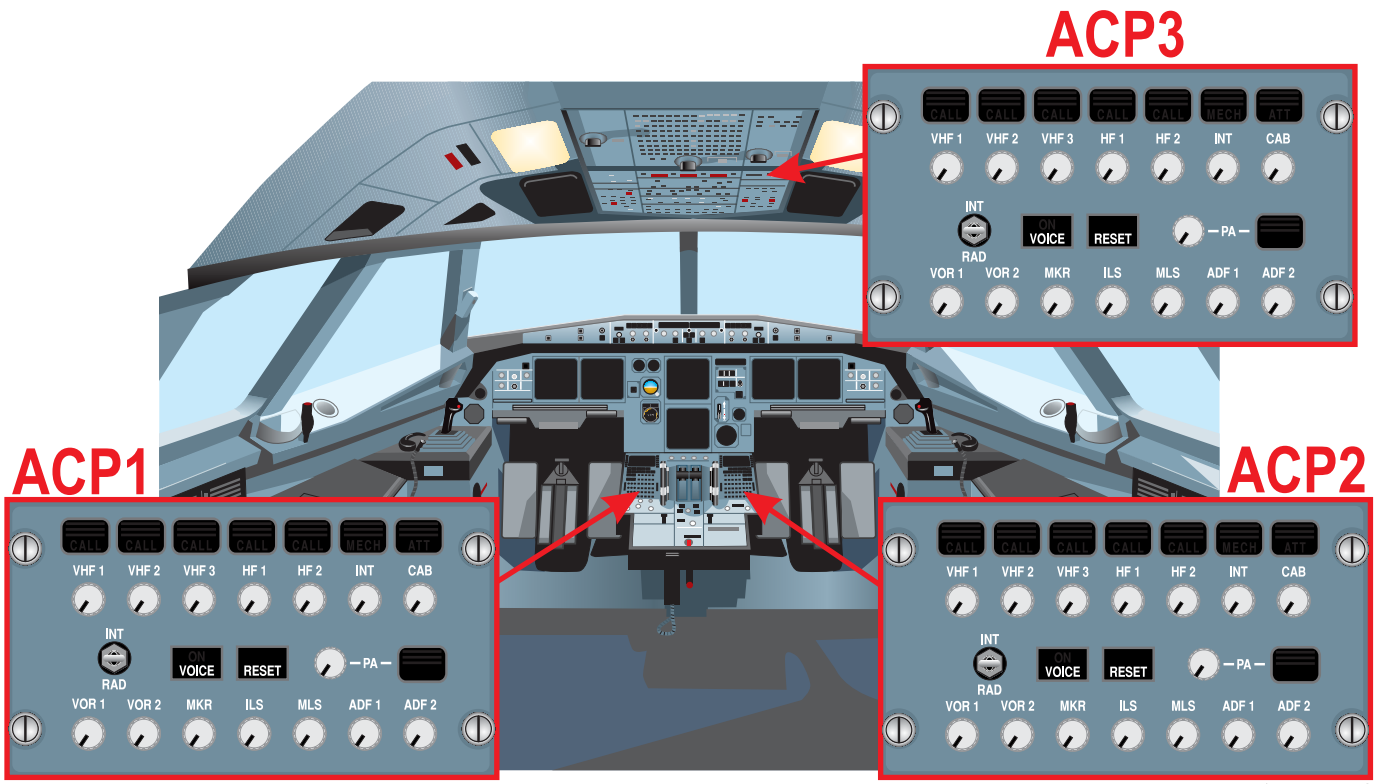


6/00 F230120C

Audio Control Panel

Function

There are three audio control panels (ACPs). There are two located on the pedestal and one on the overhead panel.

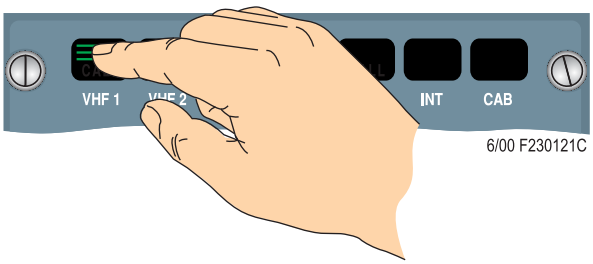


6/00 F230078C

Audio Control Panel (continued)

Transmission Keys

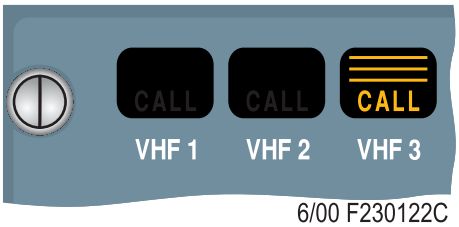
When a transmission key is pressed, the bars illuminate green, and the corresponding communication system is selected for transmission. Only one key can be selected at a time.



6/00 F230121C

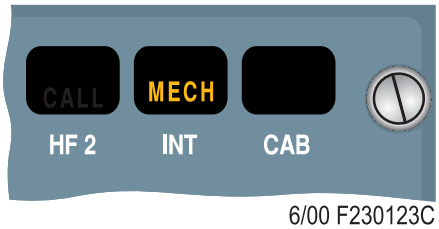
CALL - A SELCAL can be received when the appropriate frequency is selected. CALL illuminates in the corresponding key, accompanied by a buzzer. VHF1, VHF2, VHF3, HF 1, and HF2 (as installed) can receive SELCALs.

Note: The SELCAL buzzer can only be silenced by pushing the reset key on the ACP.



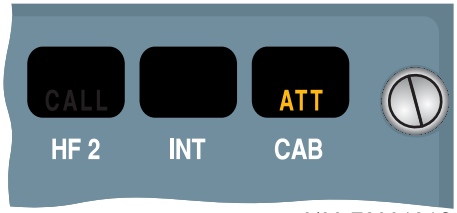
6/00 F230122C

MECH - The MECH light on the ACP flashes amber, accompanied by a buzzer, when a call is received from the service bay. If not reset, the MECH light extinguishes after a short time.



6/00 F230123C

ATT - The ATT light on the ACP flashes amber, accompanied by a buzzer, when a call is received from a flight attendant station. If not reset, the ATT light extinguishes after a short time.



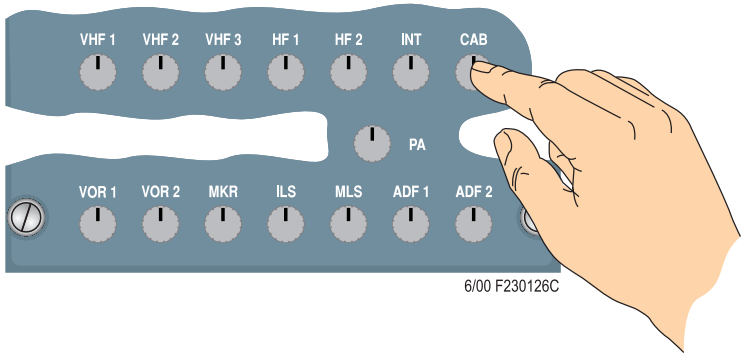
6/00 F230124C

Audio Control Panel (continued)

Reception Knobs

When pressed and released (knob out), the respective communication audio is selected and the knob's white integral light illuminates. The knob can be rotated to adjust the volume.

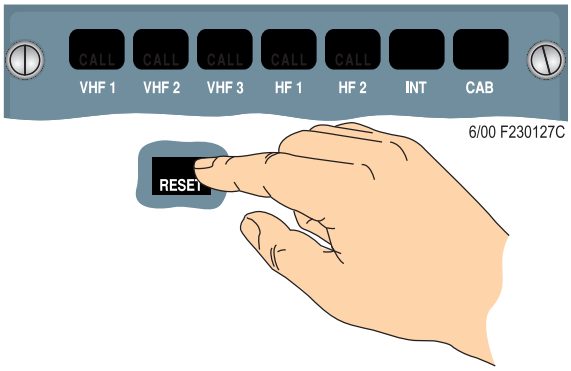
When pressed (knob in), the respective communication audio is switched off and the white light extinguishes.



RESET Key

After a call is received, the CALL, MECH, and ATT lights extinguish when pressed.

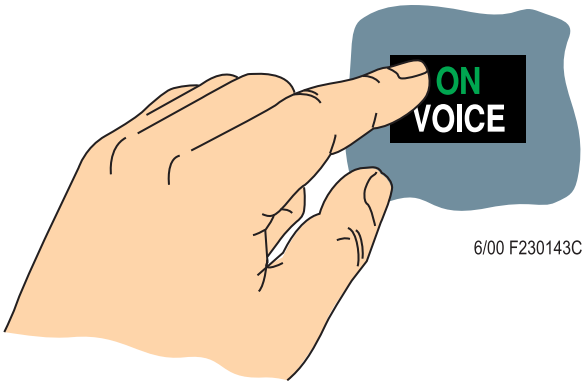
Note: The MECH and ATT lights automatically extinguish after a short time if the call is not cancelled by the RESET key.



Audio Control Panel (continued)

VOICE Key

Used to inhibit the navaid morse code audio identifier signals. The recorded voice navaid identifier will still be heard. When pressed, ON illuminates green and the morse code is filtered out. This configuration is used when VHF voice reception is desired through a navaid.



INT/RAD Switch

INT (HOT MIKE)

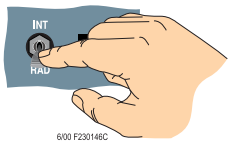
Hands free flight interphone transmission is available when using the boom or oxygen mask microphones. For reception, the INT audio knob must be selected out (illuminated).

Neutral

The boom and oxygen mask microphones are disconnected for flight interphone transmission. Flight interphone reception is not affected.

RAD

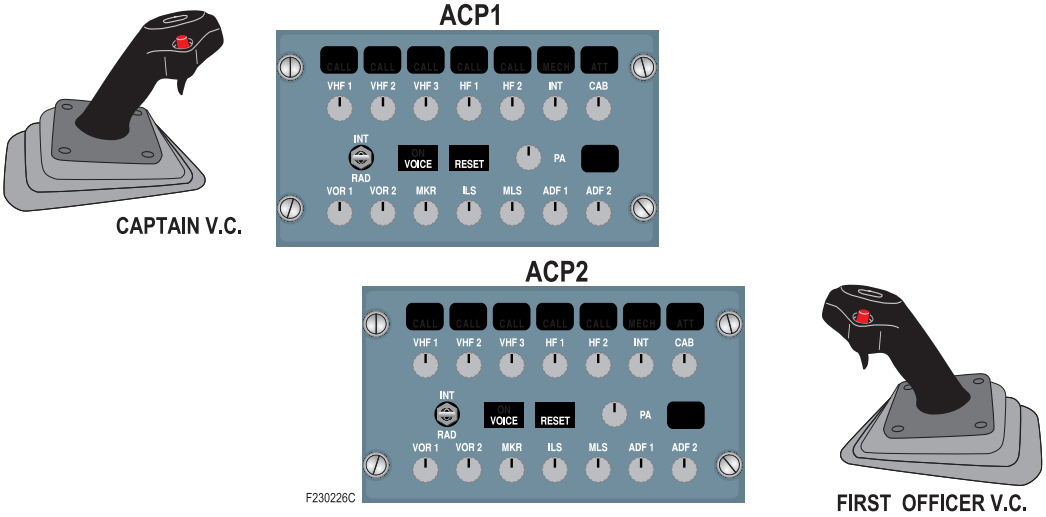
The spring loaded RAD switch must be pressed and held to operate. It is used to talk via the boomset or oxygen mask microphones via the radio selected by a transmission key.



Sidestick Microphone Switch

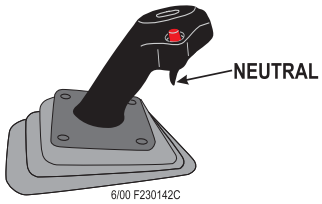
Function

Used to talk via boom or oxygen mask microphones.



Neutral

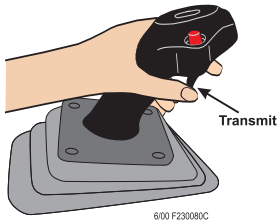
This trigger switch is spring-loaded to neutral. The boom and oxygen mask microphones are disconnected from transmission.



Transmit

The transmit position is obtained by pulling the trigger aft. This position is used to talk by boom or oxygen mask microphones via the radio selected by the transmission key on the ACP.

Note: If transmit is selected on the sidestick when the INT/RAD switch on the ACP is set to INT, the transmit function has priority over the interphone function. (i.e., the transmission side tone will be heard canceling out flight interphone conversation).

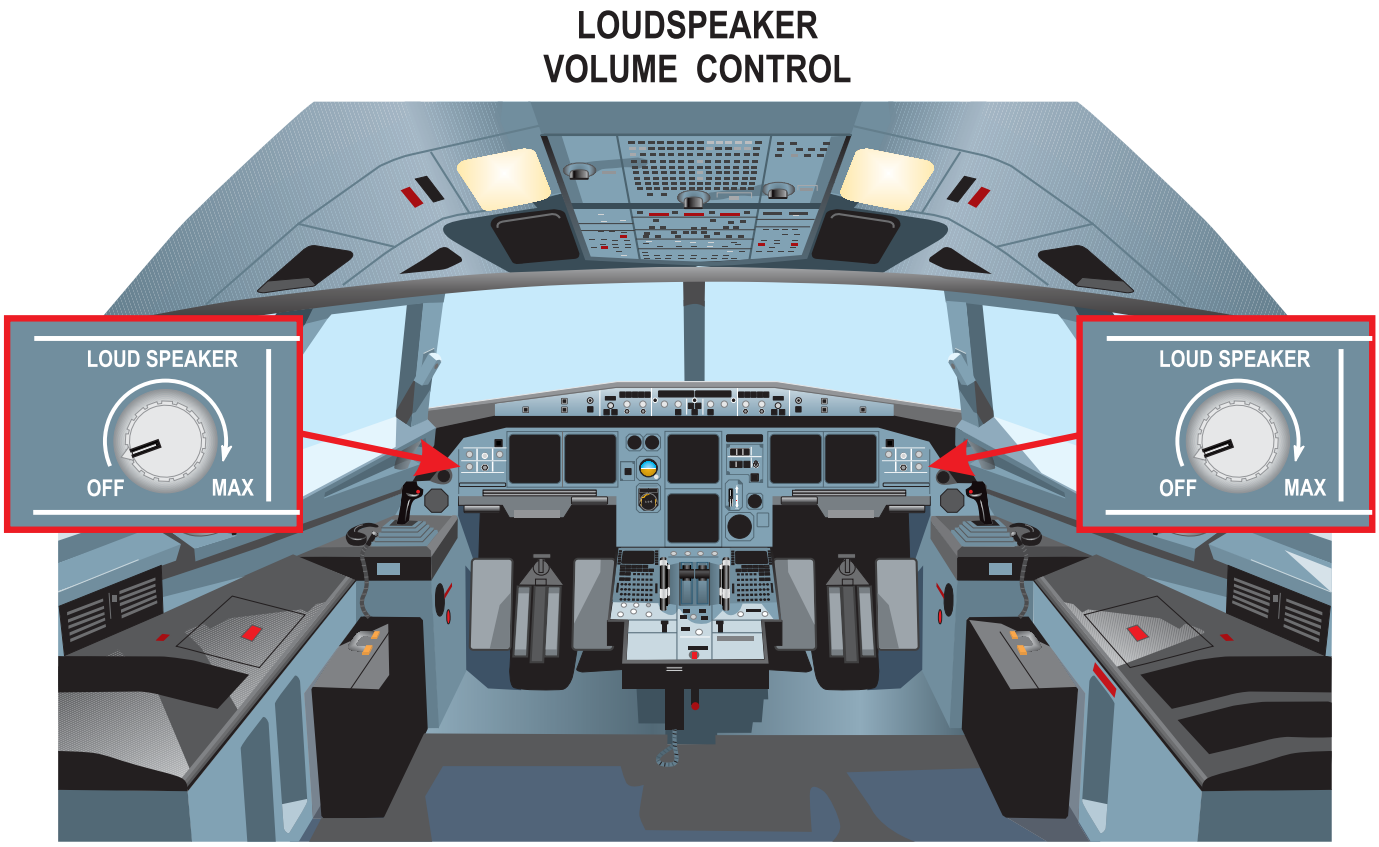


Loudspeaker Switch/Volume Knob

Function

This switch is used to control the use and volume of the respective loudspeaker

.



6/00 F230128C

OFF

The loudspeaker is switched off. All aural warnings and cautions can still be heard regardless of the position of this control.

Turning Clockwise

Volume of the loudspeaker is increased.

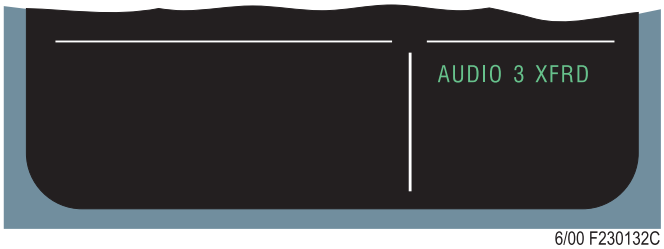
Audio Switching

Function

In case of a failure of the captain's or first officer's ACP, the audio switching selector permits replacement of the failed ACP with ACP3.

When transferred, the third occupant's headset, boom microphone, oxygen mask microphone, and hand microphone are not usable.

The message "AUDIO 3 XFRD" is displayed in green on the ECAM MEMO display.



6/00 F230132C

NORM

Each crew member uses their dedicated ACP.

6/00 F230129C

CAPT ON 3

Captain makes all ACP selections from ACP3.

6/00 F230130C

F/O ON 3

First officer makes all ACP selections from ACP3.

6/00 F230131C

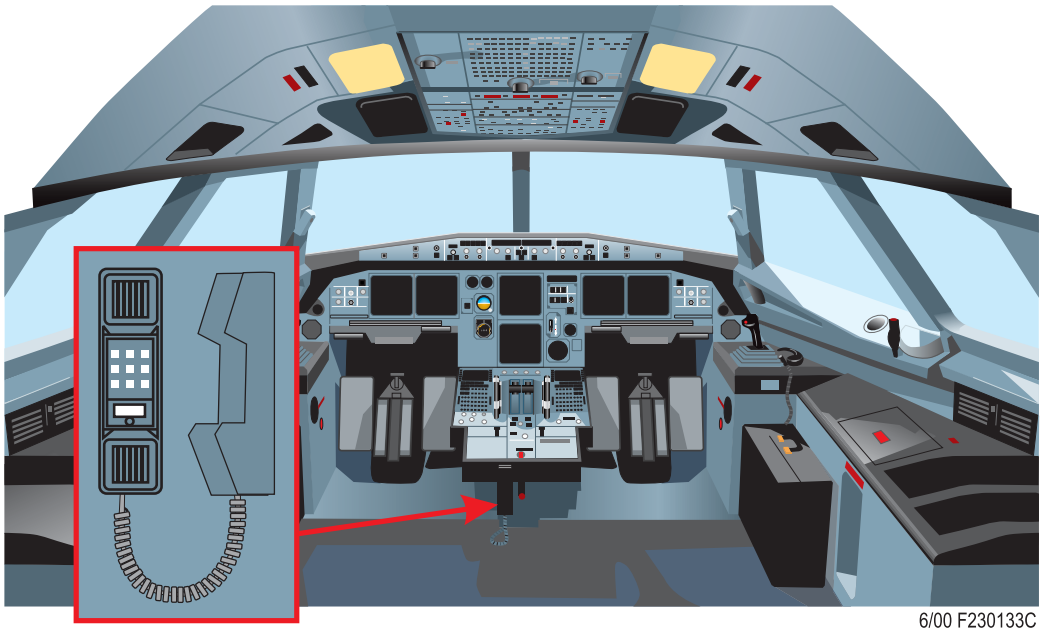
Public Address (PA) Controls

Function

The PA system is used for passenger announcements and can be operated from the flightdeck or cabin.

In the flightdeck , the PA can be operated from the ACP or the PA handset mounted on the pedestal.

From the cabin, the PA can be operated from both the forward or aft flight attendant stations.

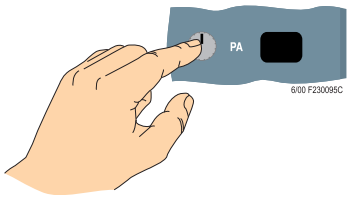


6/00 F230133C

PA Reception Knob

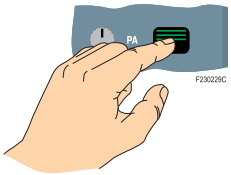
Knob Out - The white integral light illuminates and the audio is switched on. Rotate the knob to adjust the volume. Cabin PA announcements can be monitored.

Knob In - The audio is switched off.



PA Transmission Key

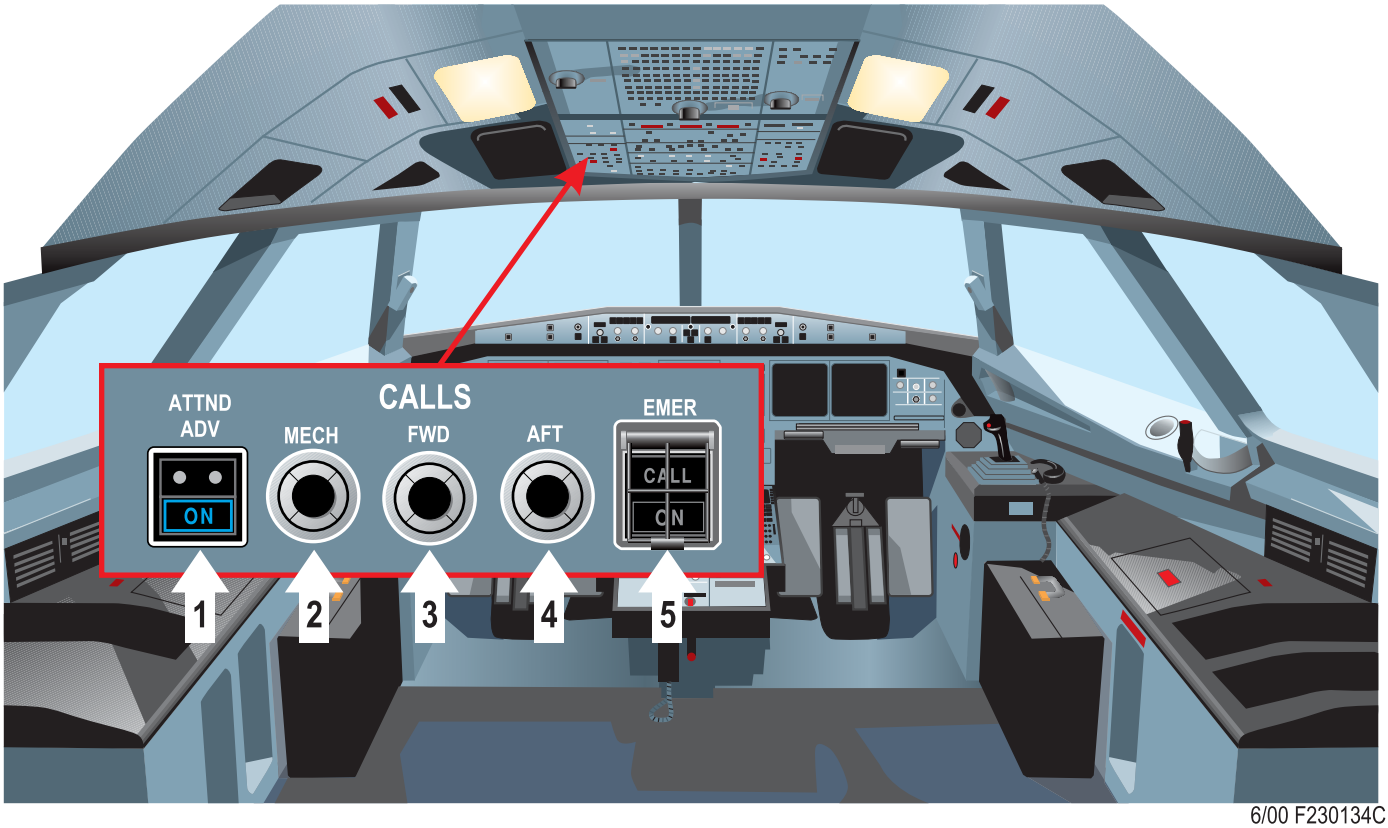
When pressed and held, the bars illuminate green and the boom microphone, oxygen mask microphone, or hand microphone may be used for public address transmissions.



Cabin Calls System

Function

The CALLS panel controls audio and visual communications between the flight crew and the flight attendant stations.



6/00 F230134C

1. ATTND ADV pb (not used by Delta)

ON illuminates blue when pressed.

It will also illuminate a steady red light on the cabin Calls panels.

2. MECH pb

When pressed and held, the COCKPIT CALL light on the service bay communication panel illuminates blue. An external horn also sounds.

Calls System (continued)

3. FWD pb

When pressed, a pair of red lights illuminate at the forward attendant area call panel. The CAPTAIN CALL message appears at the forward attendant indicating panel. A high/low chime also sounds through both forward and aft attendant loudspeakers.

4. AFT pb

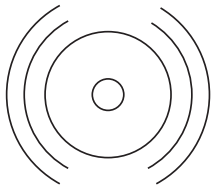
When pressed, a pair of red lights illuminate at the aft attendant area call panel. The CAPTAIN CALL message appears at the aft attendant indicating panel. A high/low chime also sounds through both the forward and aft attendant loudspeakers.

5. EMER pb

ON (pilot initiated)

CALL illuminates amber, ON illuminates white, and a pair of red lights at all attendant area call panels illuminate. The message EMERGENCY CALL appears at the attendant indicating panels. Three high/low chimes sound through both forward and aft loudspeakers.

6/00 F230135C



DING
DONG

DING
DONG

DING
DONG

6/00 F230104C

CALL (flight attendant initiated)

CALL illuminates amber, ON illuminates white, and a buzzer sounds three times when an emergency call is performed from the cabin to the cockpit.

6/00 F230135C

A CIDS reset is achieved when the attendant stows the respective handset.

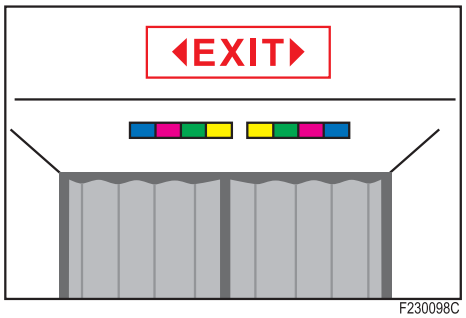
Flight Attendant Communication Equipment

Area Call Panel

There are three sets of flight attendant call panels in the aircraft cabin: forward, mid, and aft. All are mounted on the ceiling panel and are used to visually alert the flight attendants.

The area call panel uses four colors: pink, blue, green, and amber. The definition of each color is described below.

- pink- normal call or emergency call from the flight deck,
- blue - call from a passenger seat location,
- green - Currently not used. Illuminates when ATTND ADV p/b on cockpit overhead CALLS panel is selected ON.
- amber (steady) - call from the respective lavatory or
  amber (flashing) - smoke in the respective lavatory.



F230098C

Attendant Indicating Panel (AIP)

There is an AIP visible from each flight attendant seat location. This panel displays call system status messages.

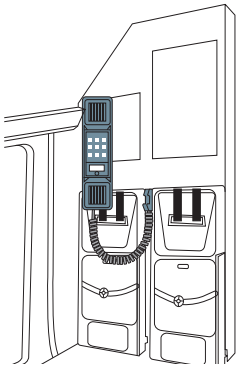
F230099C

Flight Attendant Handset

There are three flight attendant handsets in the cabin. One is located near the forward cabin entrance between the flight attendant jump seats. The other two are located adjacent to the aft flight attendant jump seats

The handset can be used to:

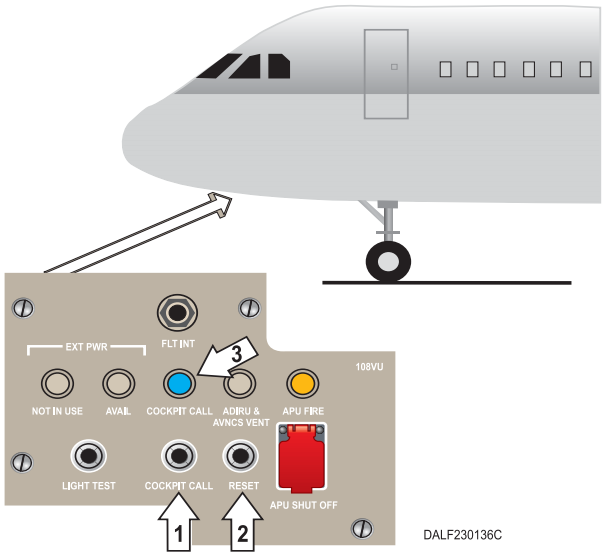
- make PA announcements,
- call each flight attendant station, or
- call the cockpit.



External Power Panel Controls

Function

Used for communication between the ground crew and the cockpit.



1. COCKPIT CALL pb

When pressed, MECH on the ACP panel in the cockpit illuminates amber, signaling a call from the external power panel. A buzzer also sounds in the cockpit.

2. RESET pb

The cockpit call light on the external power panel is reset.

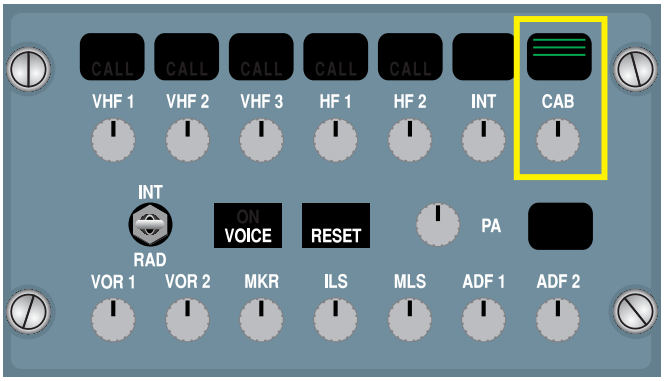
3. COCKPIT CALL Light

The light illuminates blue and a horn sounds when the cockpit calls the ground crew.

Cabin Transmission/Reception

Function

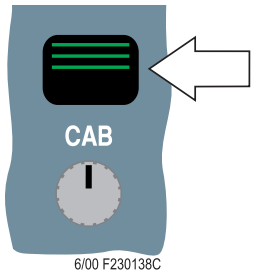
These controls are used to transmit or receive from the cabin and service interphone.



6/00 F230137C

CAB Transmission Key

When pressed, integral lighted bars illuminate green and the boom or hand microphone can be used for the cabin or service interphone.



6/00 F230138C

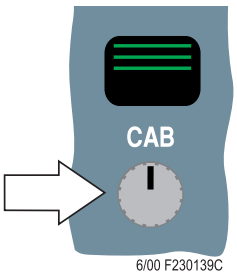
CAB Reception Knob

Knob Out

The white light illuminates and the audio signal from the cabin or service interphone is received. Rotate the knob to adjust the volume.

Knob In

The cabin and service interphone audio is switched off and the white light extinguishes.



6/00 F230139C

Service Interphone Controls

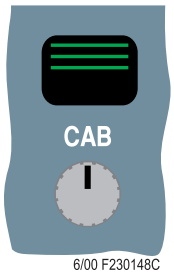
SVCE INT OVRD Switch (MX Only)

The service interphone override switch is located on the overhead panel. It is used to communicate via service interphone jacks during maintenance operations requiring the aircraft to be elevated on hydraulic jacks and the landing gear raised.

Pedestal Controls

The service interphone uses the CAB transmission key and reception knob.

Note: Maintenance personnel have no method of signaling the flight crew from an exterior jack location to initiate a conversation. The flight crew must be aware that a service interphone communication is desired.



6/00 F230148C

Cockpit Voice Recorder (CVR) Controls

Function

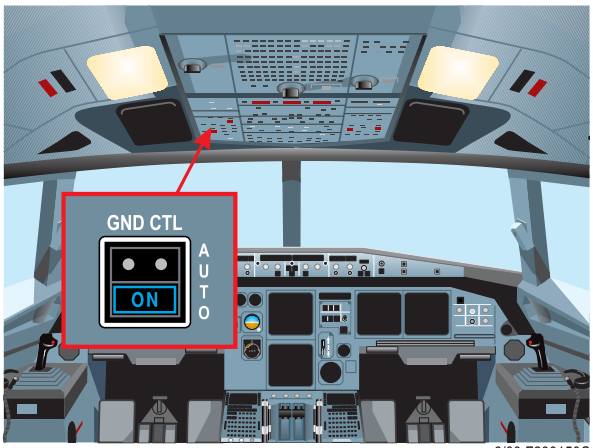
The CVR controls are used to manually control, erase the tape, and test the CVR.

F230149C

GND CTL Switch

ON - The CVR and Digital Flight Data Recorder (DFDR) are energized. ON is illuminated.

AUTO (lights out) - The CVR is automatically energized upon the first engine start or for five minutes after electrical power is applied to the aircraft.



6/00 F230150C

CVR ERASE pb

When pressed for a short period of time, complete erasure of the tape occurs provided the aircraft is on the ground and the parking brake is set.

6/00 F230152C

CVR TEST pb

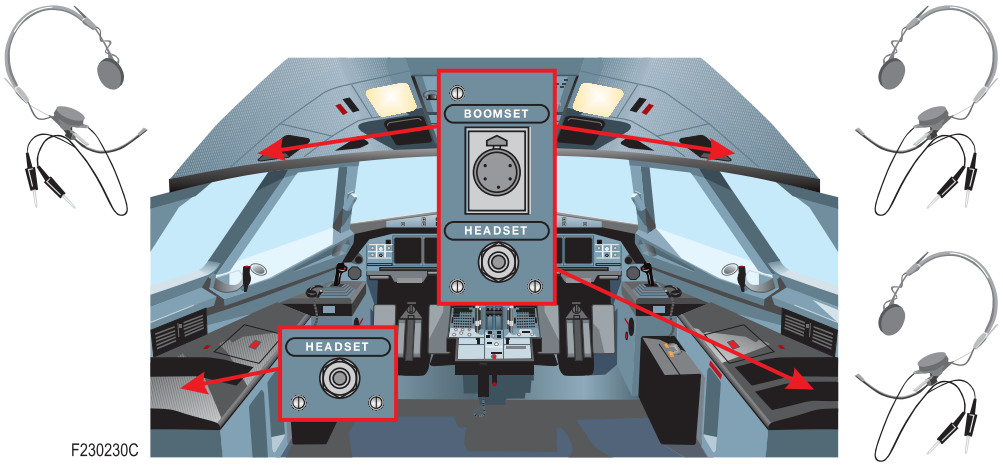
When pressed and held with the parking brake on, the test is activated provided the CVR is energized, and low frequency tone is heard. The parking brake must be set for this test to occur.

6/00 F230152C

Flight Deck Communication Accessories

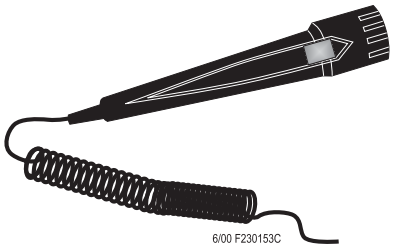
Headset

Three Telex headsets with boom style microphones are provided in the flight deck. Flight deck jack locations are shown in the diagram below. If you choose to use a personal headset, an adapter is required to convert from the PJ-055/PJ-068 type connectors (standard on U.S. aircraft) to the XLR5 type connector, (standard on Airbus).



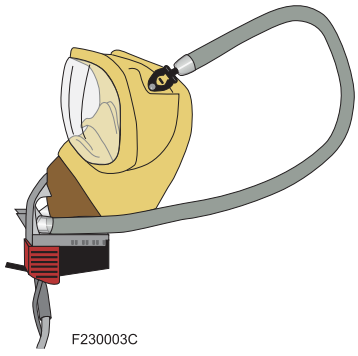
Hand Microphones

Three hand-held microphones with push-to-talk pbs are provided. There is one microphone on each pilot's console and one at the right XCM headset location.



Oxygen Mask Microphone

When the mask is removed from the stowage box, the microphone is activated. Three of the four flight deck oxygen masks are equipped with microphones. The oxygen mask assigned to the fourth XCM (behind the captain's seat) does not have a microphone.



Warning/Caution Messages

Communication Warnings and Cautions

The table below lists the failures and associated warnings and cautions that can occur in the communication system.

E/WD Failure Condition	Aural Warning	Master Light	System Page	Local Warning
CIDS 1 + 2 FAULT	Single Chime	Master Caution	None	None
VHF 1 (2) (3) EMITTING transmitter emitting more than 60 seconds.				
ACARS FAULT	None	None	None	None

Chapter 24: Electrical

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System Description

General Description

Purpose

The electrical system provides the aircraft with the power required to operate its electrical components.

System Overview

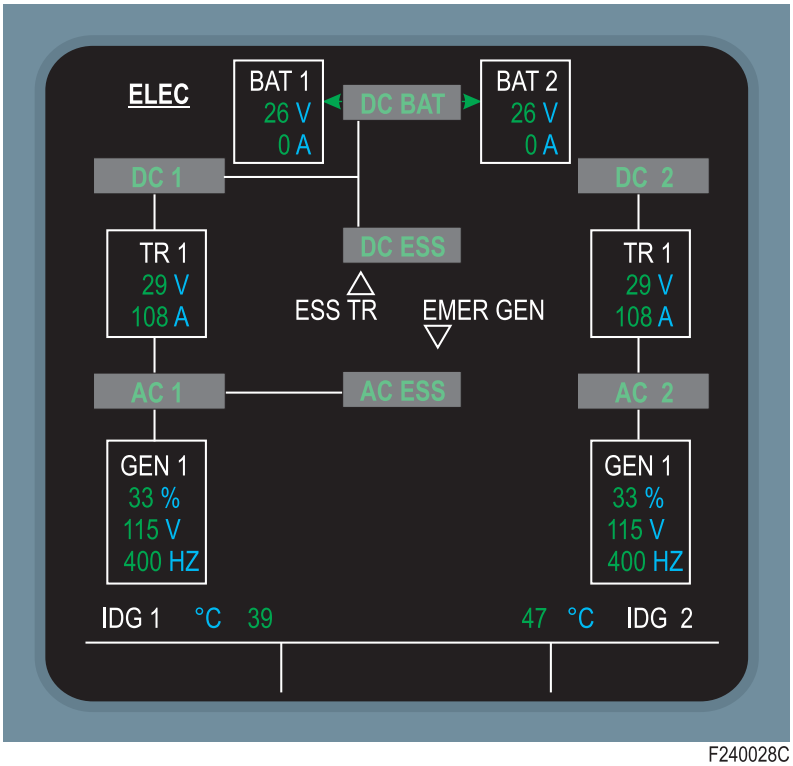
The electrical system can be powered by:

- 2 engine driven Integrated Drive Generators (IDG),
- an APU generator,
- a hydraulic powered emergency generator, or
- 2 aircraft batteries.

In addition, an external ground power unit can be connected to the system.

All controls are located on the electrical section of the overhead panel.

The operation of the electrical system is monitored by the Flight Warning Computers (FWC), and a basic operational schematic is displayed on the ECAM ELEC page.



F240028C

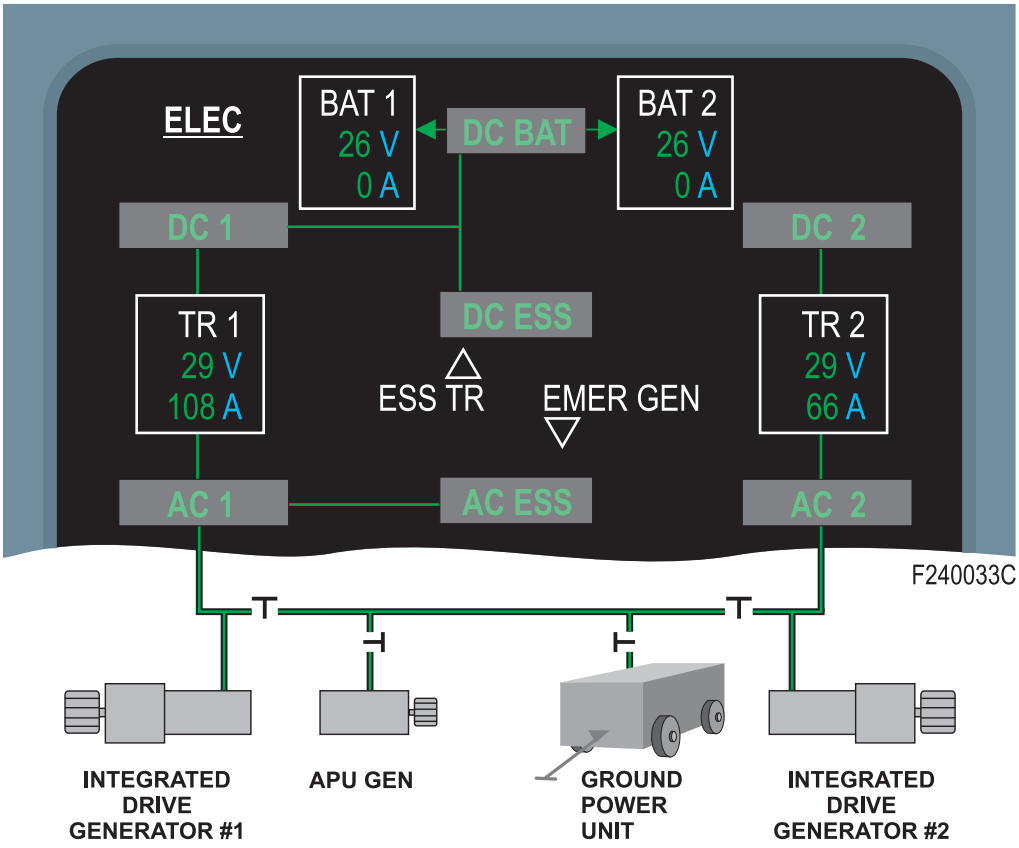
ECAM ELEC Page

AC Power Generation

Overview

Under normal operating conditions, the AC power requirements of the electrical system can be met by:

- 2 Integrated Drive Generators (IDG),
- external power unit, and
- APU generator.



When operating in the emergency electrical configuration, limited AC power is provided by the:

- emergency generator, and
- aircraft batteries

AC Power Generation (continued)

Integrated Drive Generator (IDG)

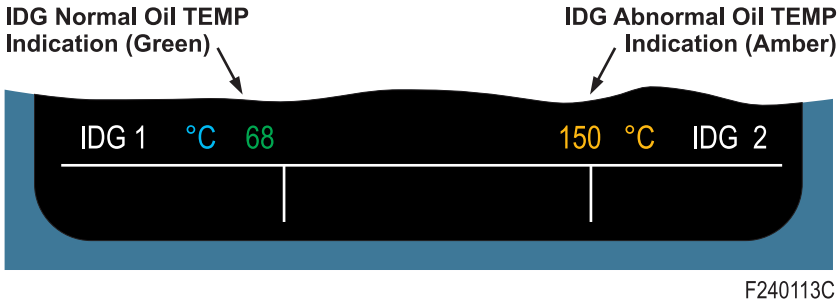
The aircraft is equipped with two engine driven Integrated Drive Generator (IDG) systems. An IDG is an all in-one unit that incorporates a Constant Speed Drive (CSD) which powers an electric generator.

IDG Function

The function of the IDG is to maintain the generator at a constant RPM throughout the associated engine's RPM range.

IDG Cooling and Lubrication

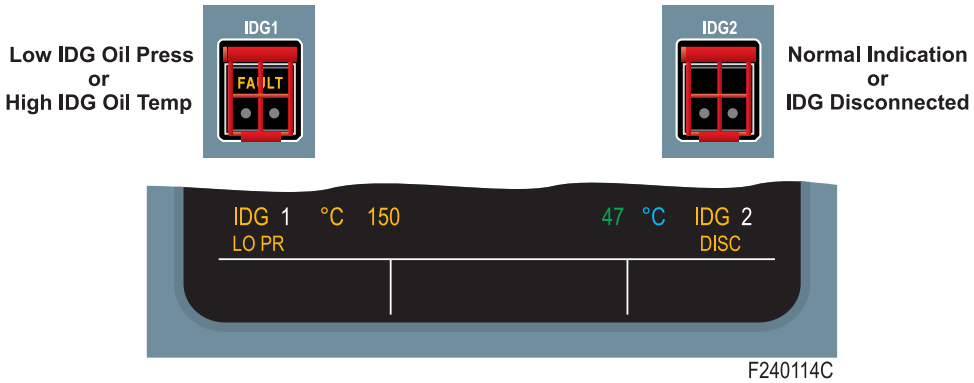
The drive mechanism of each IDG is cooled and lubricated by an oil system that is independent of the associated engine's oil system. The oil is cooled by a fuel/oil cooler which utilizes fuel flow from the associated engine's fuel supply line. IDG oil outlet temperature is displayed on the ECAM ELEC page.



IDG Disconnect

An IDG may be disconnected from its associated engine by selecting the respective red guarded IDG 1(2) pb located on the ELEC section of the overhead panel.

Disconnecting an IDG renders the associated electrical generator inoperative. Once disconnected, an IDG cannot be re-connected in flight.



IDG pbs are normally lights out. However, an IDG pb illuminates FAULT (amber) when either oil temperature or pressure exceeds preset limits. The pb returns to lights out when these parameters have returned to normal or when the IDG has been disconnected.

However, in the case of an IDG disconnect, IDG DISC remains in view on the ECAM ELEC page.

Caution: *The IDG must be disconnected with the engine at or above idle thrust to prevent damage to the disconnect mechanism. Do not press an IDG pb for more than 3 seconds.*

AC Power Generation (continued)

IDG Electric Generator Function

The generator portion of an IDG consists of an electric generator which can power the entire electrical system. Under normal conditions, IDG 1 provides power to AC Bus 1 and IDG 2 powers AC Bus 2.

GEN pbs, located on the ELEC section of the overhead panel, control generator operation. When selected on, the pb is lights out; when selected off, the word OFF appears on the pb.

Generator power output is monitored by its respective Generator Control Unit (GCU) for correct power output (freqs/volts).

In the event of malfunction, or if the associated engine is not operating and the pb is selected on, the word FAULT appears.

Note: The GEN pbs are normally kept in the on position therefore, FAULT appears prior to engine start.

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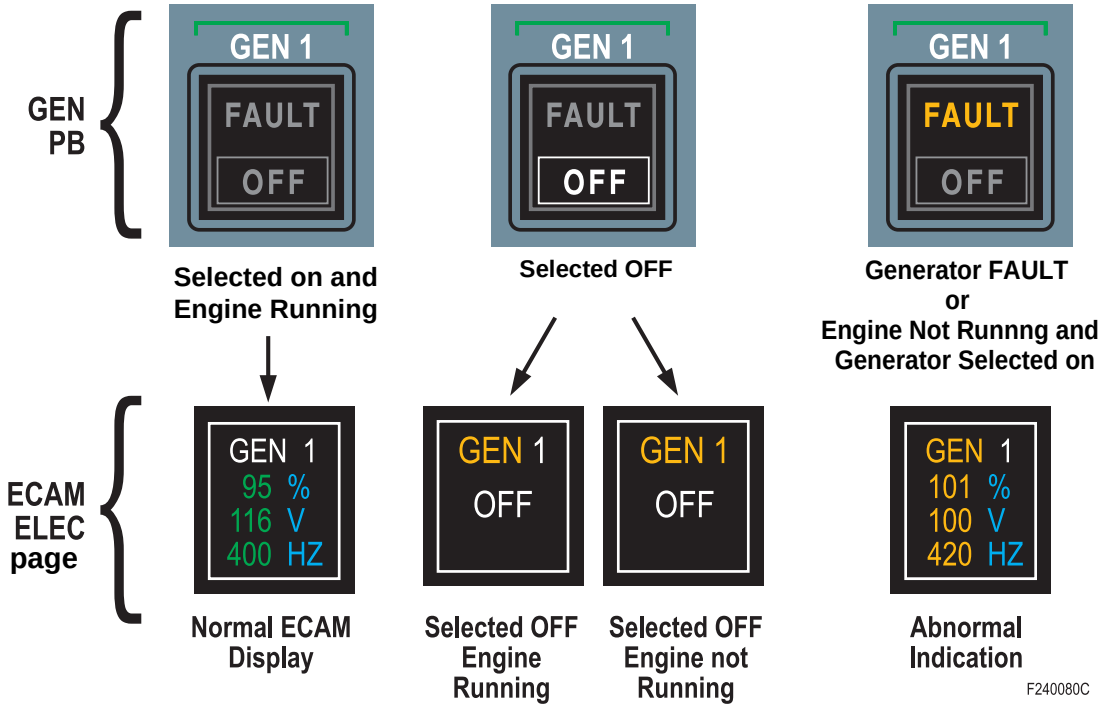


AC Power Generation (continued)

APU Generator

The APU generator is identical to an IDG generator with the exception that it is not equipped with the constant speed drive feature.

The APU generator can be used both in flight and on the ground as the sole source of electrical power or in conjunction with a single IDG generator.

On the ground, the APU generator is capable powering the aircraft's entire electrical system.

In flight, capabilities of the APU generator are the same as on the ground with the exception that, if it were the sole source of power, the Main Galley buses would automatically shed.

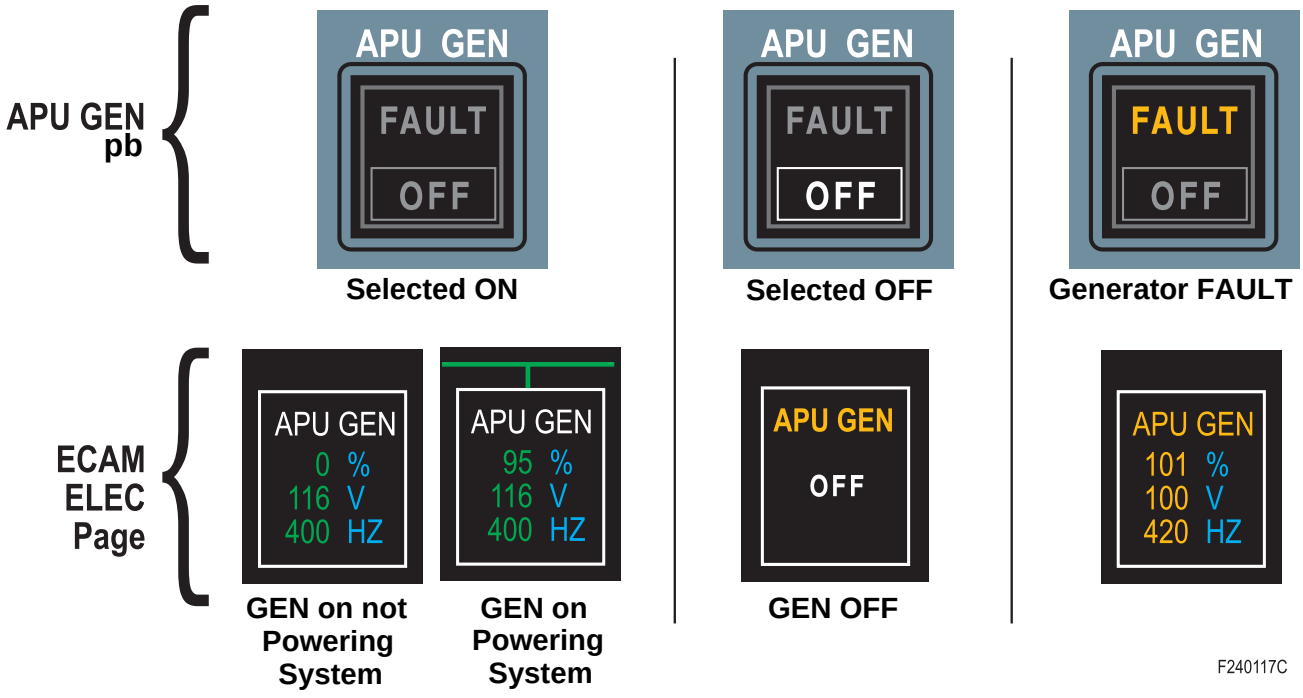
Note: At higher altitudes, the APU generator's load capacity is decreased due to generator limitations.

The APU generator is selected on or OFF by the use of the APU GEN pb located on the ELEC section of the overhead panel. When selected on, the pb is lights out.

Note: The APU GEN pb is normally left in the on (lights out) position.

When the APU is operating and the APU GEN pb is selected on (lights out), the APU generator's status is displayed on the ECAM ELEC page.

A FAULT light in the APU GEN pb illuminates amber and an ECAM caution is generated when an APU generator fault is detected.



AC Power Generation (Continued)

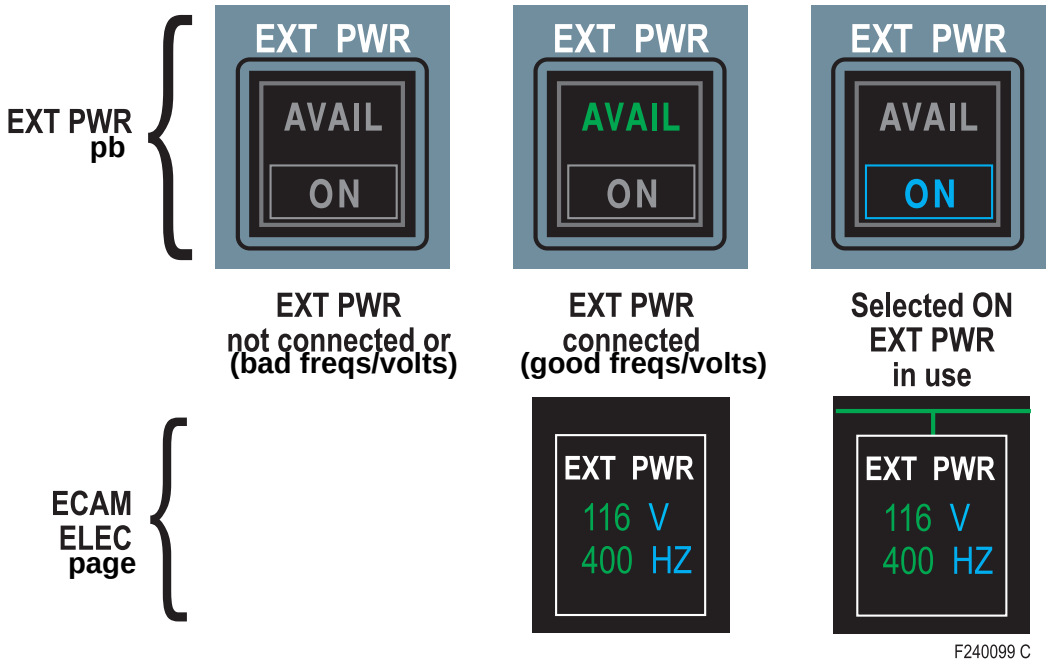
External Power

The aircraft's entire electrical system can be powered by a single external power unit. External power is connected to the aircraft at the external power receptacle located forward of the nose gear wheel well.

Note: External power can be applied exclusively to the ground servicing bus via the MAINT BUS switch without powering the entire electrical system (see MAINT BUS switch in section 24.20 for additional information).

When external power is connected to the aircraft, a Ground Power Control Unit (GPCU) verifies that the freqs/volts and are within limits. If the freqs/volts are acceptable, a green AVAIL light illuminates on the EXT PWR pb. The AVAIL annunciation indicates that EXT PWR is connected but not in use.

Note: The aircraft batteries do not have to be ON to get the AVAIL indication.



When AVAIL is illuminated on the EXT PWR pb, external power can be applied to the electrical system by selecting the EXT PWR pb. When selected, AVAIL is replaced with a blue ON indication. ON indicates external power is in use.

External power is deselected by pressing the EXT PWR pb. If external power remains connected to the aircraft, ON is replaced with AVAIL. If external power was removed prior to deselecting, the pb will be lights out. (See AC Power Priority in this section.)

The electrical system cannot automatically select or deselect external power. It must be manually selected.

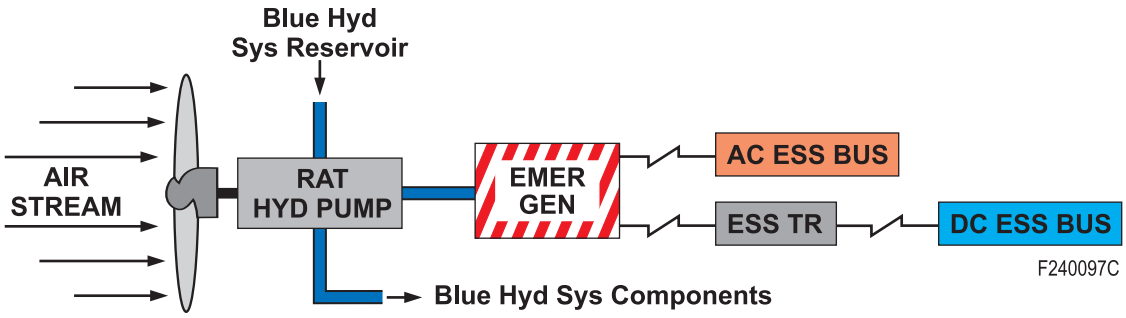
External power freqs/volts and can be monitored on the ECAM ELEC page. In addition, at the external power receptacle, ground personnel can determine whether or not external power is in use (See External Power Panel for additional details).

AC Power Generation (continued)

Emergency Generator

The electrical system is equipped with a hydraulically powered emergency generator. Its function is to provide power to the AC and DC Essential buses in-flight, if AC Buses 1 and 2 are unpowered. In this case, the electrical system degrades to the emergency electrical configuration.

The emergency generator is powered by the Ram Air Turbine (RAT). When deployed, the RAT extends into the air stream and pressurizes the Blue Hydraulic system, which drives the emergency generator.



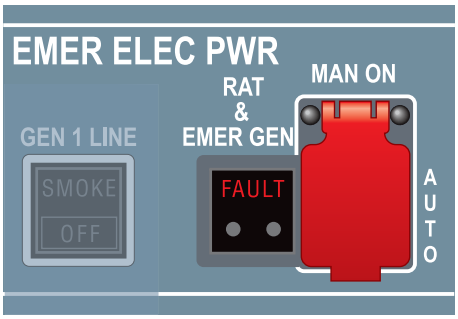
The emergency generator can be activated either automatically or manually:

Automatic activation:

- In-flight, a loss of AC Bus 1 and 2 will automatically trigger the RAT to deploy and activate the emergency generator.

Manual activation:

- Selecting the guarded MAN ON pb on the EMER ELEC PWR section of the overhead panel will trigger the deployment of the RAT and activate the emergency generator.



Warning
Actuation of the MAN ON pb even with no power on the aircraft will cause immediate deployment of the RAT and could cause injury or death.

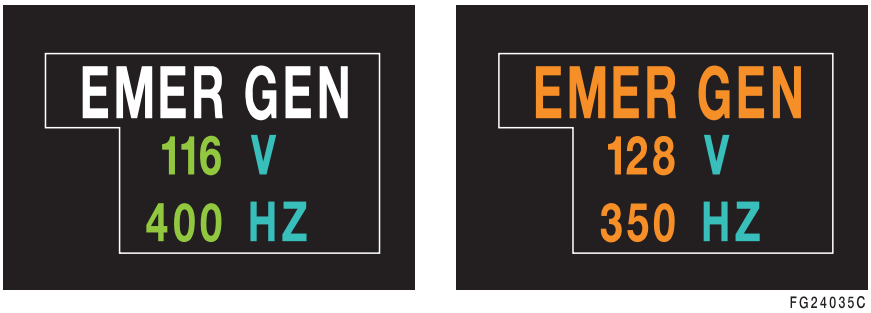
F240098C

A red FAULT light next to the MAN ON pb illuminates if the emergency generator is not providing power to the AC and DC ESS buses when power to AC bus 1 and 2 is lost.

AC Power Generation (continued)

Emergency Generator (cont)

When operating, the emergency generator's freqs/volts are displayed on the ECAM ELEC page (See emergency electrical configuration for further details).



Normal Indications **Abnormal Indications**

Note: On the A320, the emergency generator is automatically de-energized when the landing gear is extended, at which time the AC and DC ESS Buses revert to battery power. On the A319, the emergency generator continues to provide power following landing gear extension until airspeed decreases below 100 kts.

Note: The MAN ON pb can also be used to reset the emergency generator's operation, *e.g.,* a go-around is performed in the emergency electrical configuration and the landing gear is raised.

AC Power Distribution

AC Bus 1 and 2

AC power is normally distributed to the electrical system from AC Bus 1 and 2 in the following manner:

AC Bus 1 powers:

- AC ESS Bus
- TR 1

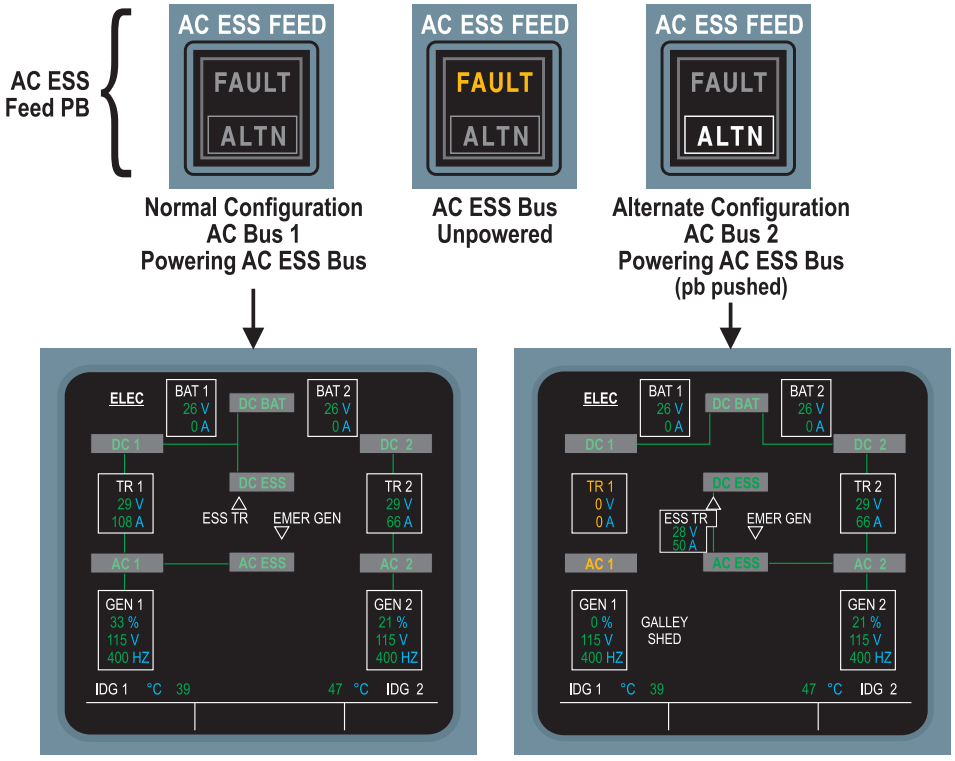
AC Bus 2 powers:

- TR 2

AC ESS Bus

The AC ESS FEED pb, located on the Electrical section of the overhead panel, is used to control which AC Bus will power the AC ESS Bus. In the normal (lights out) configuration, AC Bus 1 will power the AC ESS Bus. If AC Bus 1 fails or becomes unpowered, AC Bus 2 can be used to power the AC ESS Bus by selecting the AC ESS FEED pb. When selected, ALTN appears on the pb. An amber FAULT appears on the pb whenever the AC ESS Bus is unpowered.

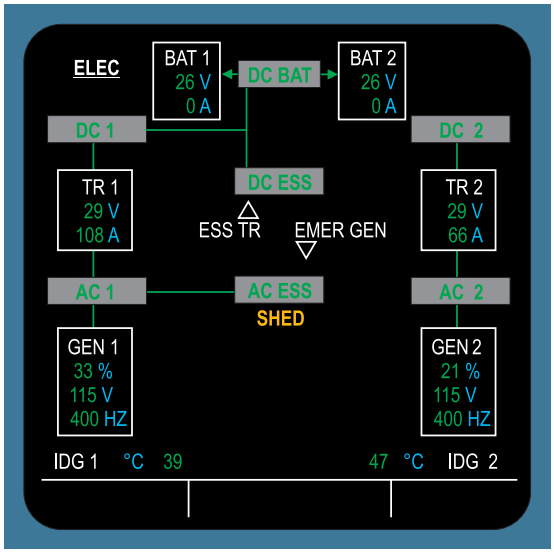
Note: All aircraft have been modified to allow AC Bus 2 to automatically power the AC ESS Bus if AC Bus 1 fails or becomes unpowered. In this case, the ALTN light in the pb will not illuminate.



AC Power Distribution (continued)

AC ESS Shed Bus

The AC ESS Shed Bus is powered by the AC ESS Bus. The ECAM ELEC page does not display the AC ESS Shed Bus unless the bus has faulted or is unpowered, in which case the word SHED (amber) is displayed below the AC ESS display.



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AC Ground/Flight Service Bus

The AC Ground/Flight Service Bus is used when the aircraft is being serviced and there is no need to power the entire electrical system network. It is normally powered by EXT PWR but can be powered by AC Bus 2, if necessary.

The AC Ground/Flight Service Bus is not displayed on the ECAM ELEC page.

AC Power Priority

AC Bus 1 and 2 Power Priority Order

The electrical system receives power through AC Bus 1 and 2. These two buses have a power priority preference which is controlled by the Bus Tie. The Bus Tie will permit power to be applied to AC Bus 1 and 2 individually in the following preferential order:

1st - respective engine driven generator (IDG)

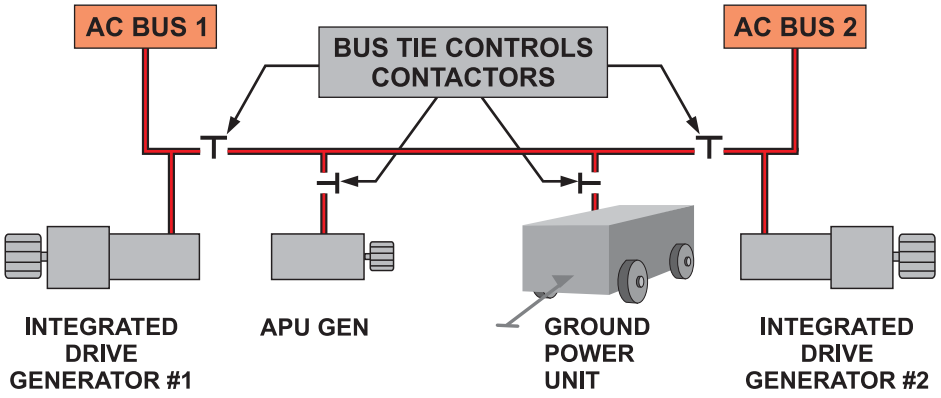
2nd - external power (if selected ON)

3rd - APU generator

4th - opposing engine driven generator (IDG)

Bus Tie

The Bus Tie controls the power priority by sensing which power source/s are available. It then commands certain Bus Tie Contactors to open or close in order to maintain a power supply to AC Bus 1 and 2.



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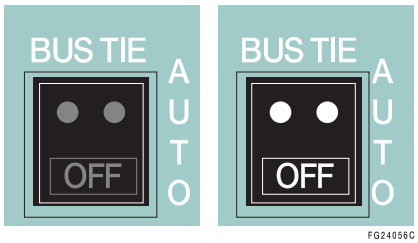
The BUS TIE pb, located on the electrical section of the overhead panel, is used to select the operating mode of the Bus Tie. When the pb is selected to AUTO (lights out), the Bus Tie operates in the AUTO Mode and applies power to AC Bus 1 and 2 in the preferential order listed above.



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When the pb is selected OFF, the Bus Tie is deactivated and certain Bus Tie Contactors open preventing the following power sources to be applied to the electrical system:

- External power,
- APU generator, or
- opposing generator.

When the Bus Tie is selected OFF, the only power source that can be applied to AC Bus 1 and 2 is their respective engine driven generator.

AC Power Priority (continued)

Bus Tie Operation Scenarios

The following scenarios are examples of Bus Tie operation (Refer to the priority preferential order):

Bus Tie pb AUTO:

Scenario #1-The aircraft is at the gate, external power has been selected ON and the APU generator is operating. In this case, the Bus Tie will only permit external power to be applied to AC Bus 1 and 2. Should external power be deselected, the APU generator will automatically power AC Bus 1 and 2.

Scenario #2 -The aircraft is on the ground, engine 1 and the APU are operating, engine 2 has not yet been started. In this case, the Bus Tie will allow AC Bus 1 to be powered by generator 1 and AC Bus 2 to be powered by the APU generator. Should the APU be shut down prior to starting engine 2, engine 1 generator will automatically power AC Bus 2.

Scenario #3 -The aircraft is in flight and engine 1 has failed. In this case, the Bus Tie will allow engine 2 generator to power AC Bus 1 and 2. If the APU is started, the APU generator will automatically power AC Bus 1.

Bus Tie pb OFF:

Scenario #1 - The aircraft is at the gate, external power has been selected ON, however, the aircraft remains depowered. In this case, because the Bus Tie pb is OFF, external power cannot be applied to either AC Bus 1 or 2.

Scenario #2 - The aircraft is in flight and engine 2 has failed. AC Bus 2 will be depowered. Attempts at applying APU generator power to AC Bus 2 fail. In this case, because the Bus Tie pb is OFF, neither APU generator nor generator 1 power can be applied to AC Bus 2.

AC ESS Bus Power Priority

The AC ESS Bus is normally powered by AC Bus 1 with AC Bus 2 as an alternate power source. The AC ESS Bus has a priority logic that provides power to the bus in the following preferential order:

1st - emergency generator

2nd - AC Bus 1 or 2

3rd - aircraft batteries

Note: The AC ESS Bus priority logic is not associated with AC Bus 1 and 2 power priority logic as controlled by the Bus Tie pb.

When the electrical system degrades to the emergency electrical configuration, the AC ESS Bus will automatically accept power from the emergency generator when it becomes available.

Note: In the emergency electrical configuration, as the RAT is being deployed, the aircraft batteries will temporarily power the AC ESS Bus through a static inverter until the emergency generator is on speed.

DC Power Generation

Overview

Under normal operating conditions, DC power requirements of the electrical system are met by two Transformer Rectifiers (TR) which are powered by AC Bus 1 and 2. An ESS TR is also available during abnormal operating conditions.

Each TR's amps/volts are displayed on the ECAM ELEC page.

On the ground with no other power source available, the batteries provide DC power to a limited number components of the electrical system (See Aircraft Batteries for further details).

TR 1

TR 1 powers DC Bus 1, the DC BAT Bus and the DC ESS Bus.

Note: Although the ECAM ELEC page indicates the DC ESS Bus is powered directly by TR1, the DC BAT Bus powers the DC ESS Bus.

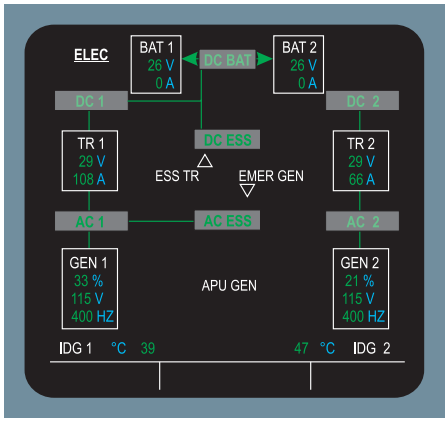
TR 2

TR 2 powers DC Bus 2.

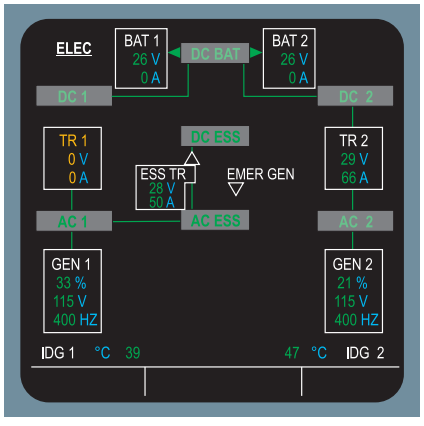
Essential TR

The ESS TR is a backup power source for the DC ESS Bus. Under normal conditions, the ESS TR is not in use. If the DC ESS Bus loses it's normal power source, the ESS TR automatically provides power to it via the AC ESS Bus. The ESS TR can be powered by either the AC ESS Bus or the emergency generator.

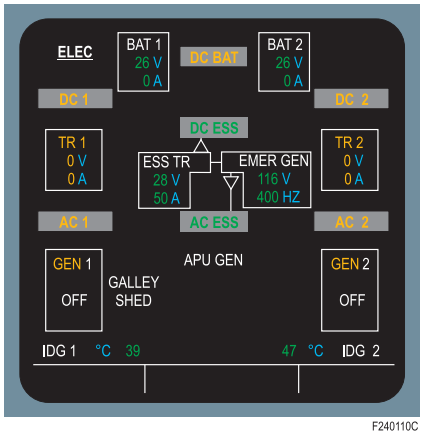
The ESS TR's amps/volts are only displayed on the ECAM ELEC page when it is in use.



Normal Configuration
Essential TR not in use



Essential TR in use
Powered by AC Essential Bus



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Essential TR in use
Powered by Emergency Generator

DC Power Distribution

DC Bus 1 and 2

DC power is normally distributed to the electrical system from DC Bus 1 and 2 in the following manner:

DC Bus 1 powers:

- DC BAT Bus
- DC ESS Bus via the DC BAT Bus
- standby power for DC Bus 2

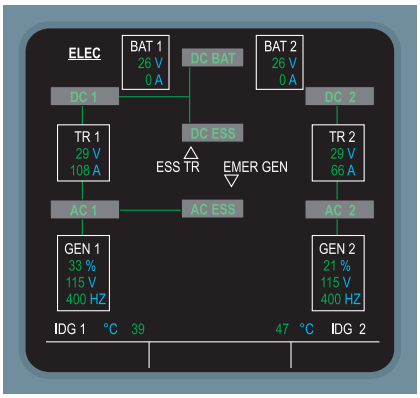
DC Bus 2 powers:

- standby power for DC BAT Bus (TR 1 failure)
- standby power for DC Bus 1 (TR 1 failure)

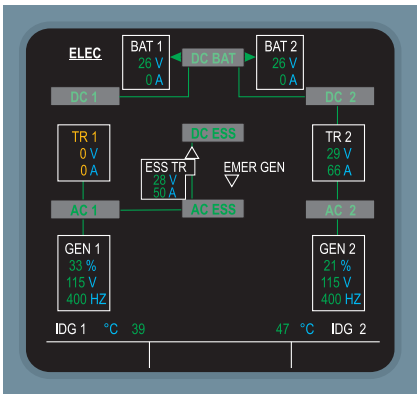
DC ESS Bus

The DC ESS Bus is normally powered by DC Bus 1 through the DC BAT Bus.

However, if TR1 should fails, the AC ESS Bus will automatically power the DC ESS Bus via the ESS TR.



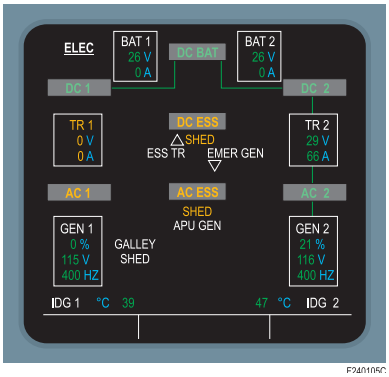
Normal Operation
TR1 Powering DC ESS via BAT Bus



TR1 has Failed
AC ESS Bus Powering DC ESS

DC ESS SHED Bus

The DC ESS SHED Bus is powered by the DC ESS Bus. The ECAM ELEC page does not display the DC ESS SHED Bus unless the bus has failed or is unpowered, in which case the word SHED (amber) is displayed below the DC ESS display.



DC ESS and AC ESS SHED Buses Unpowered

Aircraft Batteries

Overview

The electrical system is equipped with two nicad batteries. Both batteries are located in individual vented compartments located within the avionics compartment.

Battery power is primarily used for:

- APU starts
- Back-up power to the AC/DC Essential Busses

Battery Charge Limiter (BCL)

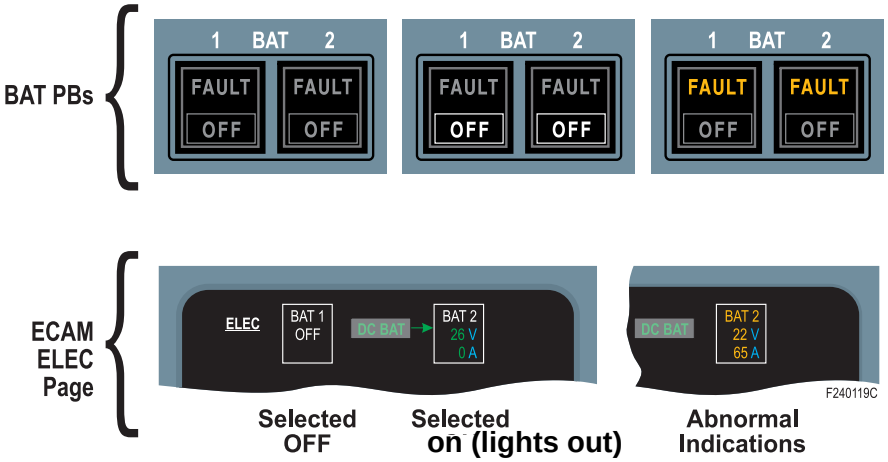
Each battery's interaction with the electrical system is highly automated and is controlled by it's respective Battery Charge Limiter (BCL). Each BCL's operation is controlled by the associated BAT 1 (2) pb located on the ELEC system section of the overhead panel.

When selected on (lights out), the respective BCL enables the associated battery to automatically:

- connect to the DC BAT BUS for charging or power the AC ESS and DC ESS buses when required, or
- sense and report battery faults.

When selected OFF, the respective battery is isolated from the electrical system. In addition, OFF appears on the respective pb and on the associated battery depiction of the ECAM ELEC page.

When a battery or BCL fault is sensed, that battery is automatically isolated from the electrical network, a FAULT (amber) appears on the respective BAT pb and an ECAM message appears.



Each BCL incorporates a disconnect logic which prevents complete battery drainage. When the aircraft is on the ground with only battery power in use, the respective BCL will automatically isolate the associated battery from the electrical system when it reaches a predetermined low voltage.

Note: The disconnect logic can be reset by toggling the associated BAT pb.

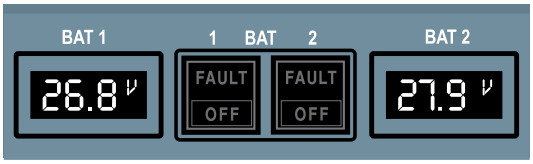
Aircraft Batteries (continued)

Battery Hot Bus

Each battery is directly connected to a respective Hot Bus. In order to unpower a Hot Bus the associated battery must be physically removed from the aircraft.

Battery Volt Displays

The voltage of each battery is displayed on individual Liquid Crystal Displays (LCD) located on the ELEC section of the overhead panel. The displays are continuously powered by the associated Hot Bus. Therefore, they are always in view.



F240100C

DC BAT Bus

The DC BAT Bus permits the batteries to connect to the electrical system in order to:

- receive a charging current
- power certain components
- start the APU

Note: In the normal electrical configuration, the batteries are rarely connected to the DC BAT BUS. In the emergency electrical configuration the batteries will not connect to the DC BAT Bus.

Battery Charging

The charging requirement of each battery is monitored and controlled by its associated Battery Charge Limiter (BCL). The respective BCL will determine if its battery requires charging; if so, the BCL will connect the battery to the DC BAT BUS. Depending on the requirement, battery charging may take as long as 20 minutes to complete.

Battery charging may be accomplished whenever the electrical system is being powered by External Power, any IDG or the APU Generator. Battery charging cannot take place when in the Emergency Electrical Configuration.

Note: The BAT pb must be selected on (lights out) in order for charging to take place.

Battery charging indications are displayed on the ECAM ELEC page.

Emergency Configuration

In flight, when the batteries are the only source of electrical power, the BCLs will automatically command:

- BAT #1 to power the AC ESS bus through a static inverter
- BAT #2 to power the DC ESS bus

Note: In flight, effective continuous battery usage is limited to approximately 30 minutes. (See QRH: Flight On Battery Power Only).

Emergency Electrical Configuration

Overview

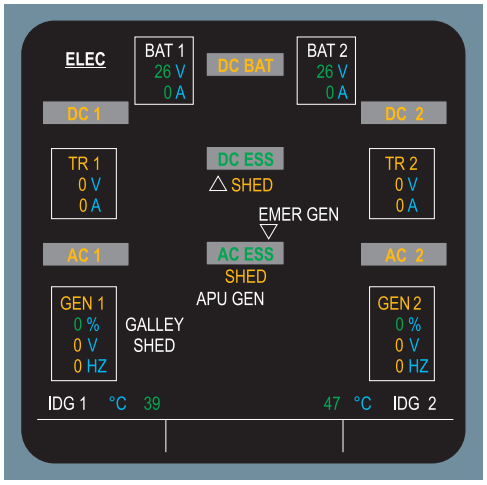
The aircraft's electrical system is designed to automatically cope with the loss of normal electrical power while in flight. This condition is referred to as the Emergency Electrical Configuration. In the emergency electrical configuration, power is provided to the essential electrical buses (AC and DC Essential) by the emergency generator.

Emergency Power Distribution

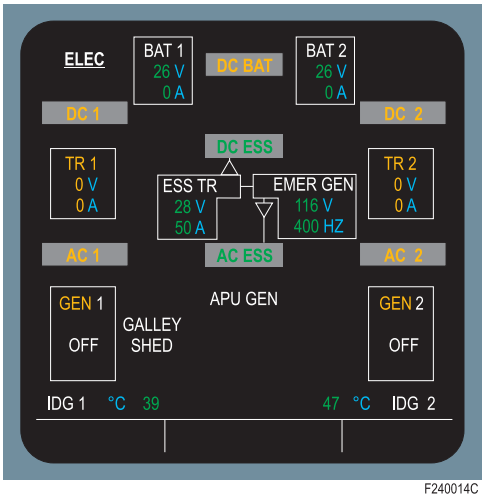
When in the emergency electrical configuration, prior to emergency generator activation, the aircraft batteries only power the AC ESS and DC ESS buses.

Once the emergency generator is on speed, it provides power to the AC ESS and DC ESS as well as their respective SHED buses.

.



Emergency Electrical Configuration prior to RAT Extension



F240014C

Emergency Electrical Configuration EMER GEN Operating

APU Starting Capability

An APU start when in the emergency electrical configuration is possible, but not recommended.

Note: APU start is inhibited for 45 seconds following the activation of the emergency electrical configuration.

Note: The electrical system is NOT capable of recharging the aircraft batteries in the emergency electrical configuration. Therefore, should the APU not start, or the APU generator has malfunctioned, the drain on the aircraft batteries during the start attempt will significantly shorten battery life.

Available Systems and Components

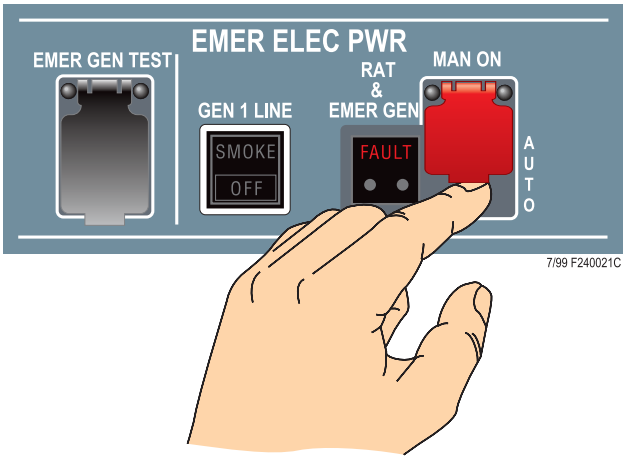
A list of aircraft systems and components that are available when in the emergency electrical configuration is available in the QRH, Section 6.

Emergency Electrical Configuration (continued)

Go Around in Emer Elec Config (A320 Only)

On the A320, if a go around is performed while in the emergency electrical configuration, raising the landing gear will not cause the emergency generator to automatically reconnect to the electrical system. The batteries will continue to be the sole power source.

However, once the landing gear is raised, the emergency generator can be manually reconnected to the electrical system by pressing the RAT & EMER GEN MAN ON pb. This action will not be necessary on the A319 since the emergency generator remains connected to the electrical system when the landing gear is lowered.



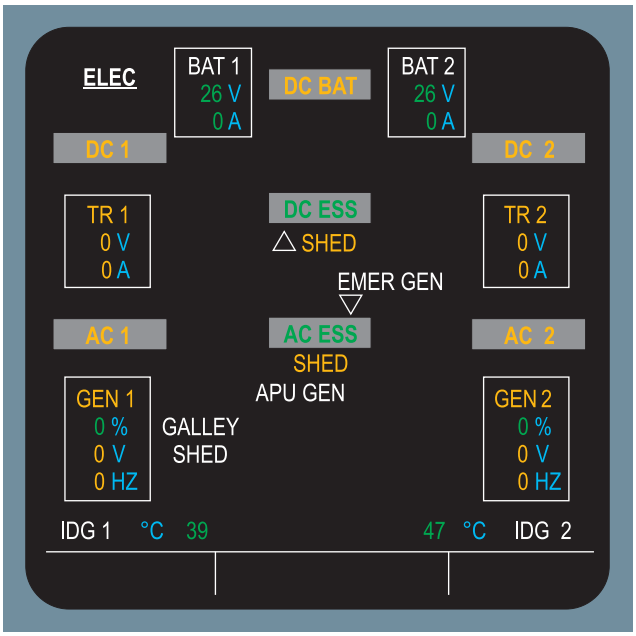
Flight On Battery Power Only

Flight on Battery Power Only

In flight, when all other electrical power sources have failed or are temporarily unavailable, the aircraft batteries will power:

- AC ESS Bus by BAT 1 through a static invertor,
- DC ESS Bus directly from BAT 2, and
- Both AC and DC ESS SHED Buses will be unpowered.

Effective continuous battery usage is limited to approximately 30 minutes.



F240109C

Flight on battery power only

Note: A complete listing of systems and components powered when in flight on battery power only, is available in the QRH, Section 6.

Avionics Smoke Configuration

General

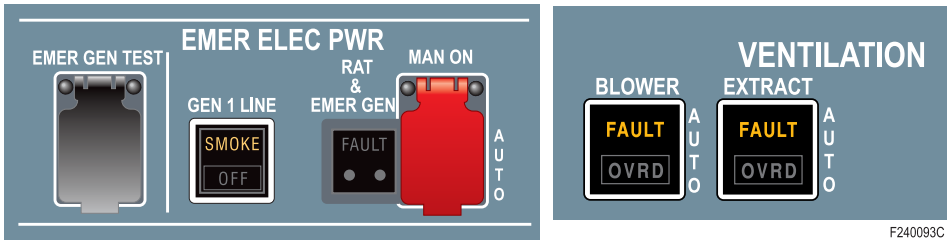
A smoke detector located within the air extraction duct of the avionics compartment, when triggered, provides the flight crew with the indications of smoke within the avionics compartment.

Caution: *When smoke is detected in the avionics compartment, the ventilation system will not automatically respond. Pilot action is required in an attempt to correct and or minimize the condition.*

Avionic Smoke Indications

In addition to the Master Warning lights, the following are also displayed:

- AVIONICS SMOKE Class 1 message on the E/WD memo section,
- ELEC page appears on ECAM,
- SMOKE appears on the GEN 1 LINE pb located on the EMER ELEC PWR panel, and
- FAULT appears on the EXTRACT and BLOWER pbs located on the VENTILATION panel.



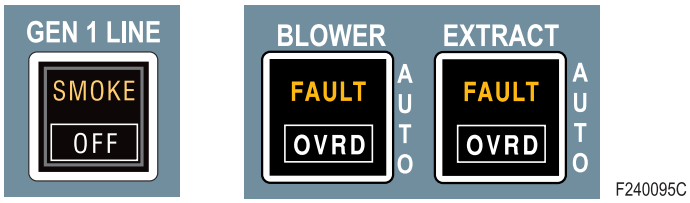
Avionic Smoke Configuration

The Avionic Smoke Configuration is a result of performing the ECAM action steps. In doing so, the pilot is directed to manually activate the emergency generator by using the MAN ON pb. In addition, generator 1 will be manually isolated from the electrical system. It will be only permitted to power one fuel pump in each wing tank.

GEN 1 is isolated by the use of the GEN 1 LINE pb. When selected, the word OFF appears on the pb. If smoke is still present, the word SMOKE remains in view on the pb.

The avionics ventilation system will be manually configured so that air within the avionics compartment is forced overboard. This is accomplished by selecting OVRD on both the BLOWER and EXTRACT pbs.

When selected, OVRD appears on the respective pbs. If smoke is still present, the word FAULT remains in view on the pbs.

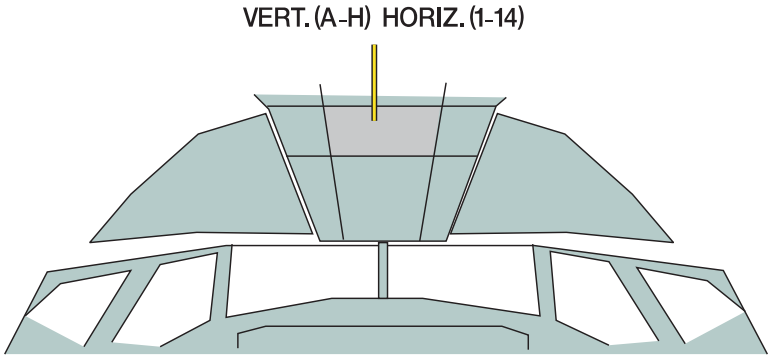


Circuit Breakers

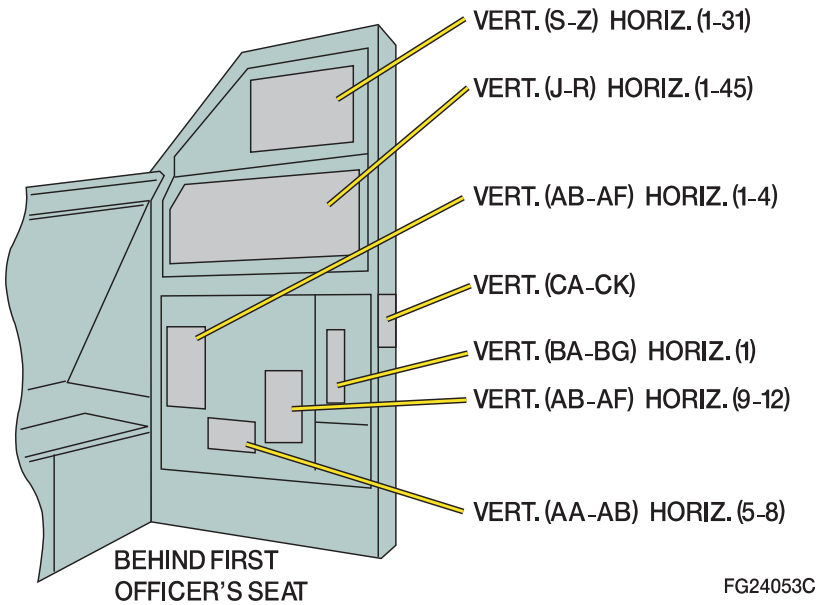
Location

The aircraft Circuit Breakers (C/Bs) are located on the flight deck at two specific locations; the aft section of the overhead panel, and the bulkhead directly behind the first officer seat. Each C/B panel is configured with an alpha numeric grid pattern to help identify a particular C/B (A-12, B-3, AB-4...etc).

All C/Bs on the overhead panel are associated with systems which are powered when the electrical system has degraded to the emergency electrical configuration.



OVERHEAD PANEL



Caution: *When performing a computer reset DO NOT pull and reset a circuit breaker unless specifically directed by the QRH, Computer Reset procedure.*

Circuit Breakers (continued)

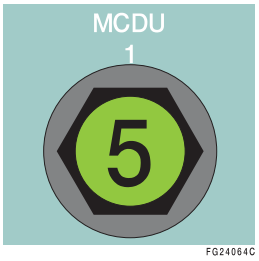
C/B Color Code

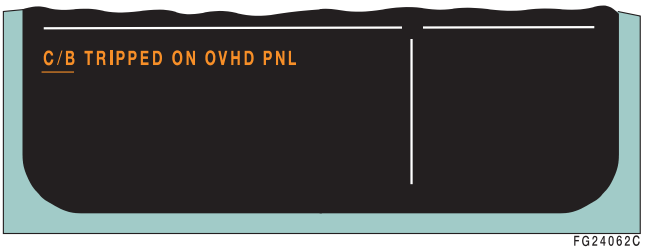
A color code is used to identify C/Bs.

Green C/Bs:

Green C/Bs and their associated systems, are monitored by the Flight Warning System. When a green C/B is tripped or pulled open, an ECAM memo message is generated.

Green C/Bs on the overhead panel which are pulled or tripped cause the following ECAM message to appear "C/B TRIPPED ON OVHD PNL."





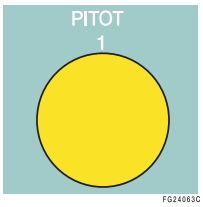
Green C/Bs on the aft bulkhead which are tripped or pulled cause the following ECAM message to appear "C/B TRIPPED REAR PNL J-M (or N-R, S-V, or W-Z)".

Black C/Bs:

Black C/Bs are not monitored by the Flight Warning System; therefore, when a black C/B is tripped or pulled there is no ECAM message generated. However, the C/B's associated system or componet may be monitored by ECAM.

Yellow C/Bs:

Two C/Bs on the overhead panel have yellow caps installed which designate them as the C/Bs to be pulled when complying with QRH procedure: Flight On Battery Power Only.



Note: Only A320 ships 3201-3270 have C/Bs equipped with a yellow cap.

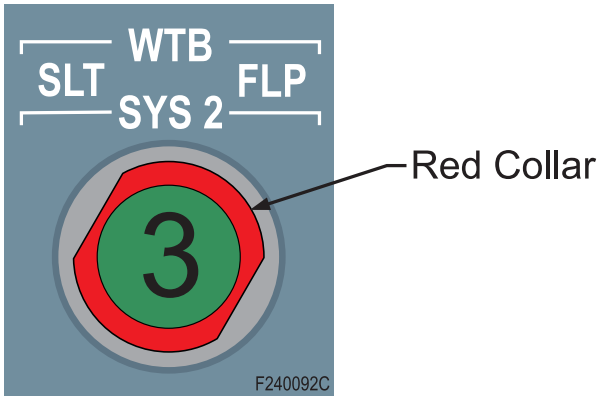
Circuit Breakers (continued)

C/B Color Code (cont)

Red collard C/Bs:

Four C/Bs on the Aft Bulkhead C/B panel are equipped with red collars. The collar prevents the crew from pulling these C/Bs.

These C/Bs are associated with the Wing Tip Brakes of the Flap/Slat Asymmetry protection system. The Flap/Slat Asymmetry system is monitored by ECAM and should any of these C/Bs open, an ECAM message will be generated.



Galley Bus Shedding

Definition

Galley Bus Shedding refers to the ability of the electrical system to shed the main galley bus when the aircraft is being powered by only one IDG or solely by the APU generator in flight.

Note: The majority of A319/320 aircraft have had the aft galley ovens removed. A small number of A320 aircraft will remain equipped with aft galley ovens.

Main and Secondary Galley Buses

The Main Galley Bus powers high load items such as the warming ovens. The Secondary Galley Bus powers low load items such as coffee makers. The galley shedding logic only affects the Main Galley Bus.

GALLEY pb

The GALLEY pb, located on the ELEC Section of the overhead panel, controls the galley shedding logic.

When the GALLEY pb is in the AUTO position (lights out) the following occurs:

On the ground:

- with External Power or APU Generator, both the main and secondary galley buses are powered
- with only one IDG powering the aircraft, the main galley bus is automatically shed.

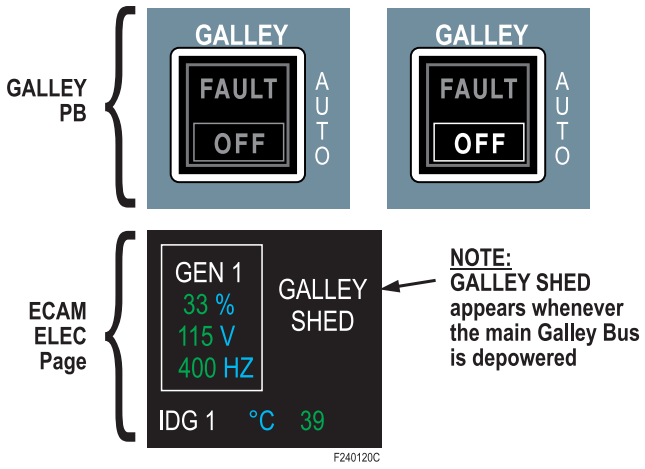
In flight:

- with only one IDG or the APU Generator powering the aircraft, the main galley bus is automatically shed; the Secondary Galley Bus remains powered. This is referred to as Partial Galley Shedding.

When the Galley pb is selected OFF, either in flight or on the ground, both the Main and Secondary Galley Buses are depowered.

Whenever the Main Galley Bus has been shed, either on the ground or in flight, the words GALLEY SHED appear adjacent to the GEN 1 text display of the ECAM ELEC page.

Note: On the A319 VIP/NBA aircraft, whenever the galley has been depowered either manually or automatically, all in-seat power is removed.



Controls and Indicators

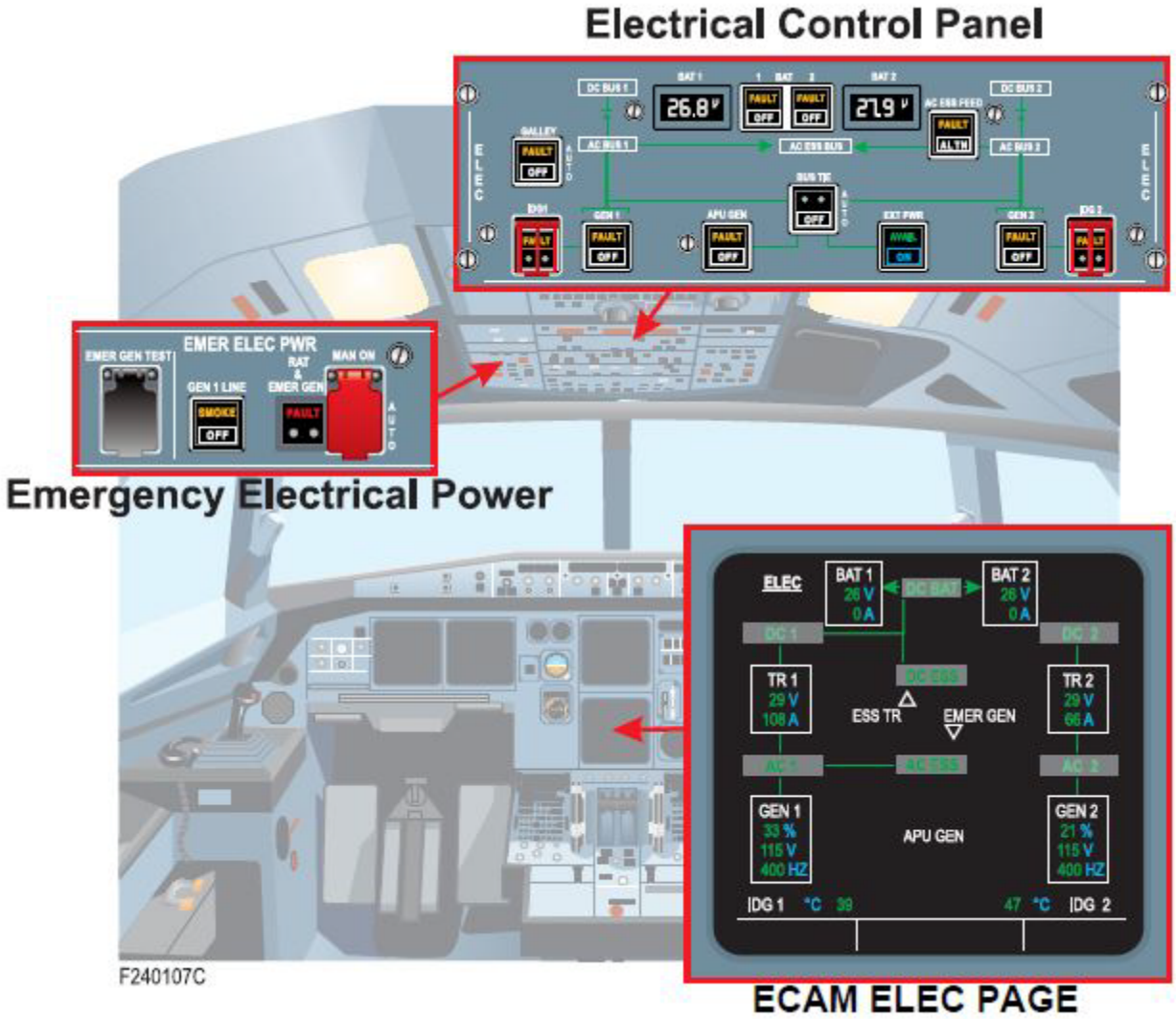
Location of Controls and Indicators

Overview

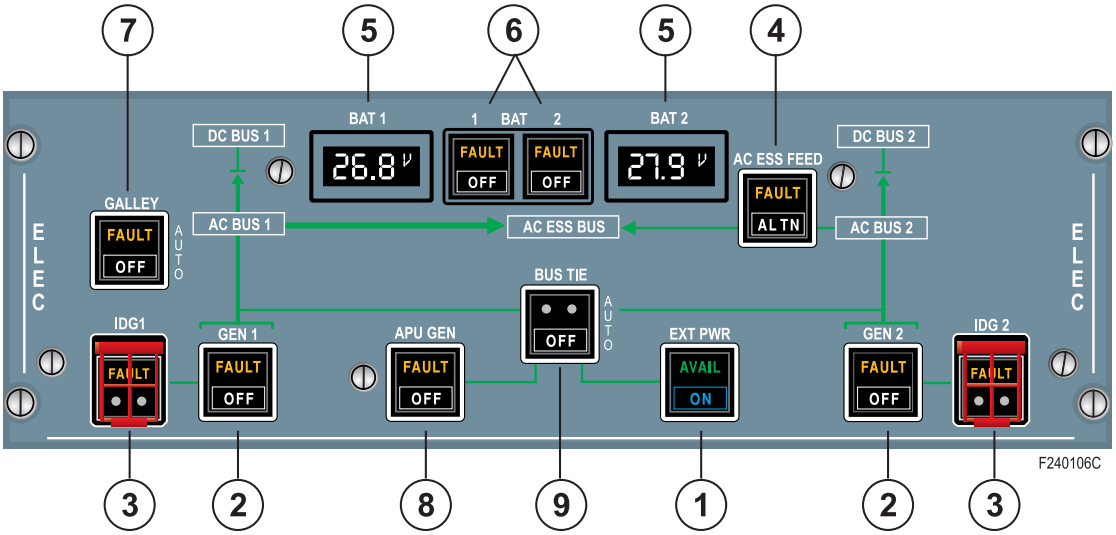
All Electrical System Controls are located on the overhead control panel of the flight deck.

Operating conditions are displayed on both the electrical system control panel and on the ECAM ELEC page.

Note: For training purposes only, all push buttons (pbs) are illuminated.



Electrical Control Panel



1 EXT PWR pb

AVAIL - external power is only connected and is within acceptable freqs/volts

ON - external power has been selected and is being applied to the electrical system

Lights out - external power is not connected or is not within acceptable freqs/volts

2 GEN 1(2) pb

Lights out - generator operating normally

OFF - selected off

FAULT - Generator Control Unit (GCU) has tripped due to a malfunction or pb selected on but the associated engine is not operating

3 IDG 1(2) pb

Lights out - normal indication

FAULT - IDG oil temperature or oil pressure have exceeded predetermined values

Caution: *To avoid damage to the disconnect mechanism, do not disconnect unless the engine is at or above idle thrust and the IDG pb should not be pressed for more than 3 seconds.*

4 AC ESS FEED pb

Lights out - normal configuration (AC Bus 1 is powering AC ESS Bus)

FAULT - AC ESS Bus unpowered

ALTN - pb is depressed, activating the alternate configuration (AC Bus 2 is powering the AC ESS Bus)

Note: Some aircraft have been modified to allow AC Bus 2 to automatically power the AC ESS Bus if AC Bus 1 fails or becomes unpowered. In this case, the ALTN light in the pb will not illuminate.

5 BAT 1(2) Voltage Display

Displays the voltage of each battery. Powered by their respective Hot Bus, the values are continuously displayed.

Electrical Control Panel (continued)

6 BAT 1(2) pb

Auto (lights out)- battery selected on; BCL automation is enabled

OFF - battery selected off; battery contactor is open

FAULT - battery charging exceeds out limits, battery contactor has opened

Note: On the ground with no other power source available, at least one battery must be on for the OFF indication to be displayed.

7 GALLEY pb

Lights out - normal indication, Main and Secondary Galley Buses are capable of being powered. In flight with only one generator operating, Main Galley Bus automatically sheds.

OFF - Both Main and Secondary Galley Buses depowered

FAULT - Any generator has exceeded its 100% output rating

8 APU GEN

Lights out - generator is commanded to operate when the APU is on speed

OFF - generator is selected off

FAULT - generator's GCU has detected a fault

9 BUS TIE

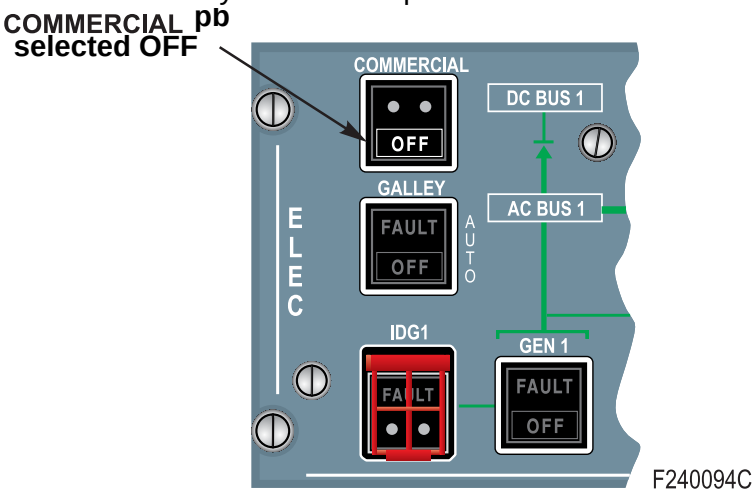
Lights out - AC Power Priority Logic is enabled

OFF - AC Power Priority Logic disabled. The electrical system will not accept power from: the External Power Unit, APU Generator or a single IDG generator.

COMMERCIAL pb (on some aircraft)

Lights out - normal indication: cabin and cargo compartment lights, water and toilet systems, passenger entertainment systems, drain mast ice protection can be powered.

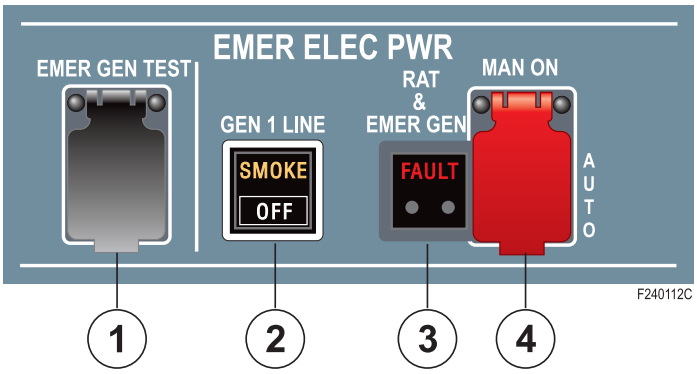
OFF - the above mentioned systems are depowered.



On some A319s and A320s

Emergency Electrical Power Panel (continued)

EMER ELEC PWR Panel



1 EMER GEN TEST

This guarded pb is used by maintenance personnel to test the operation of the emergency generator.

2 GEN 1 LINE pb

Lights out - normal indication

SMOKE - indicates smoke has been detected in the avionics compartment

OFF - when the pb is selected, indicates generator 1 has been isolated from the electrical system and is only providing power to one fuel pump in each wing fuel tank.

Note: When the pb has been selected, the word SMOKE will continue to be displayed as long as smoke continues to be detected in the avionics compartment.

3 RAT & EMER GEN

Lights out - normal indication

FAULT - in flight, the emergency generator is not supplying power to AC and DC ESS Buses when the aircraft is in the emergency electrical configuration.

4 MAN ON pb

When pressed, the Ram Air Turbine (RAT) deploys and the emergency generator is activated.

Warning

Actuation of the MAN ON pb, even with no power on the aircraft, will cause immediate deployment of the RAT and could cause injury or death.

Note: On the A320, the pb should be used to reset the emergency generator once the landing gear has been raised following a go-around in the emergency electrical configuration.

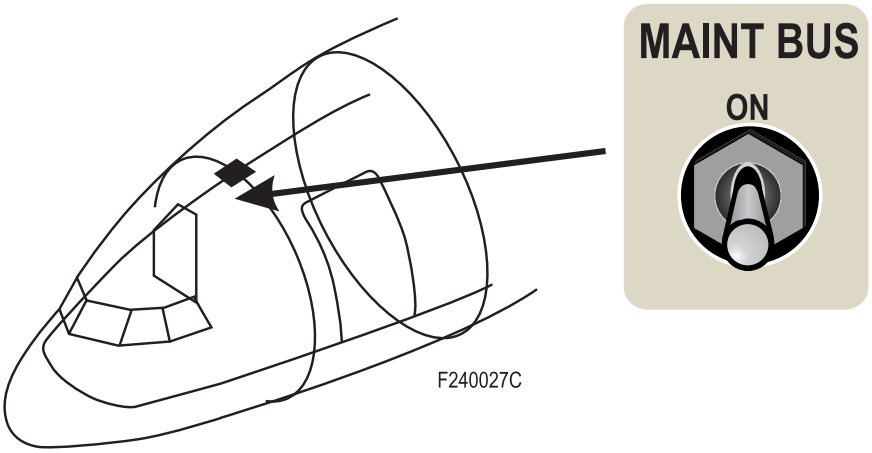
Miscellaneous Controls

Maintenance Bus Switch

On - (when manually selected, the switch is magnetically held in position), external power is permitted to energize only the ground service buses without powering the flightdeck.

Note: The ON position only functions when external power is connected (AVAIL) but not selected ON.

OFF - (Not labeled) switch is spring-loaded to this position. Can be manually selected or the switch will automatically drop to the off position should external power be removed or selected ON.

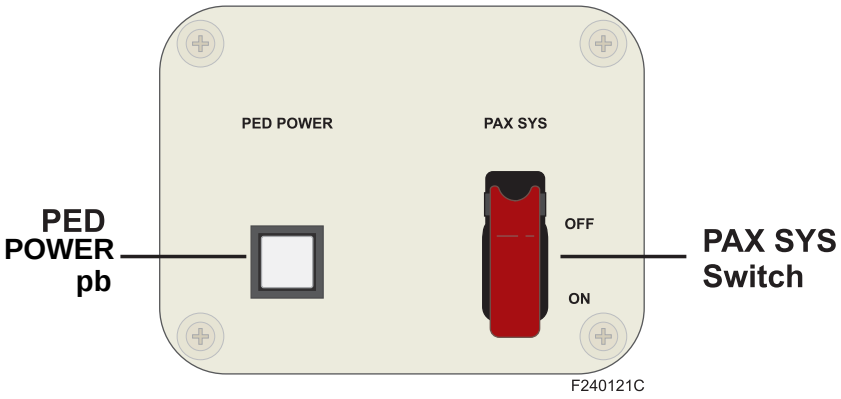


A319 VIP/NBA Seat Power Control Switches

On the A319 VIP/NBA configured aircraft, power to the cabin passenger seats can be controlled by one of two control switches located next to the Flight Attendant forward CIDS panel.

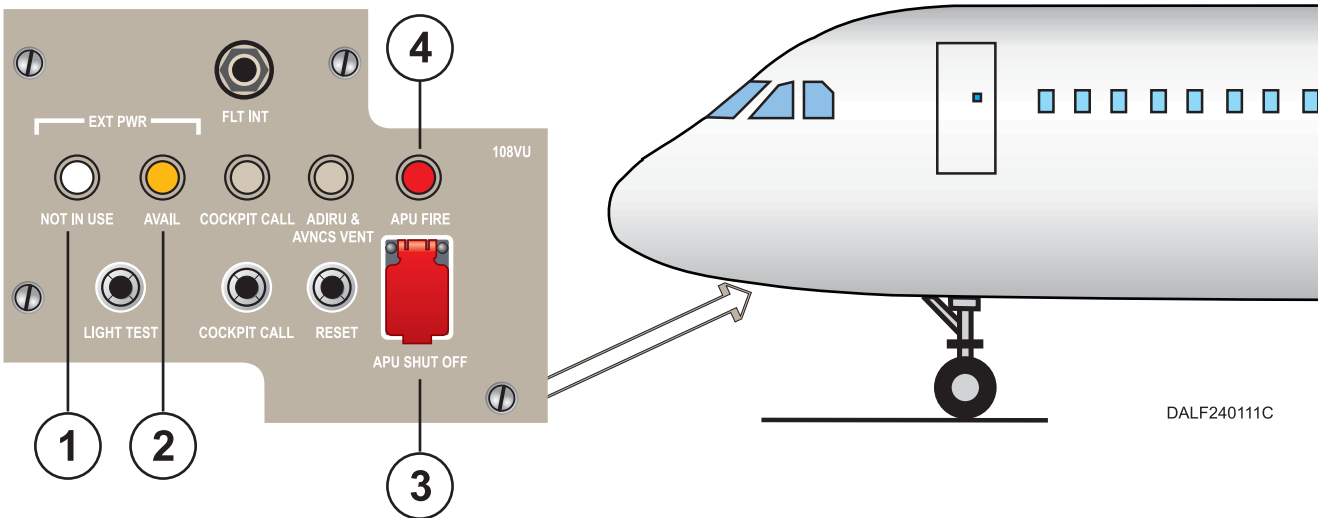
- **PED pb (Portable Electronic Device):** only removes the electrical power used for each seat's DVD player and additional seat-mounted110V AC outlets.
- **PAX SYS switch:** only removes electrical power for each seat's reading and wash lights.

Note: Complete removal of electrical power from all passenger seats can only be accomplished by the shedding of the Galley Bus or selecting OFF with the GALLEY pb.



External Power Panel

EXT PWR Panel



1 NOT IN USE light

Illuminates white - indicates that external power, although connected and operating, is not being utilized. Its meaning is the same as the AVAIL light on the EXT PWR pb on the flight deck

Lights out - with external power connected, indicates that external power is being used

2 AVAIL light

Illuminates amber - indicates that external power freqs/volts are within operating limits

3 APU SHUT OFF

Used to send a secondary shutdown signal to the APU in the event of a fire. It will also silence the APU external fire warning horn

4 APU FIRE light

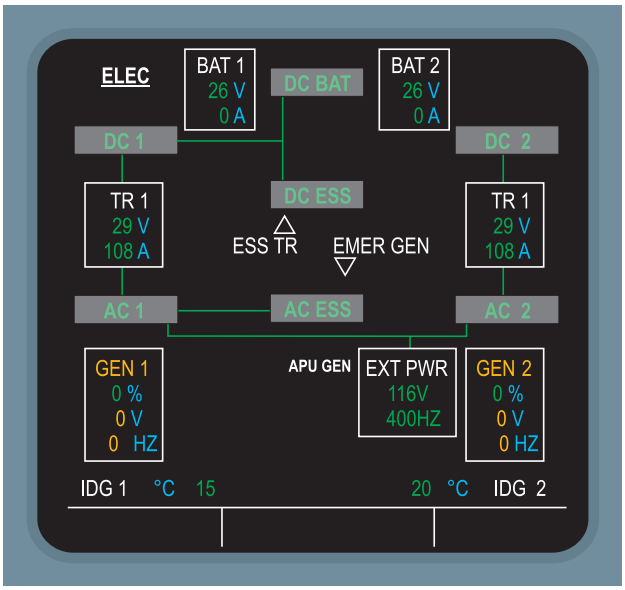
Illuminates red - indicates an APU fire has been detected

ECAM ELEC Page

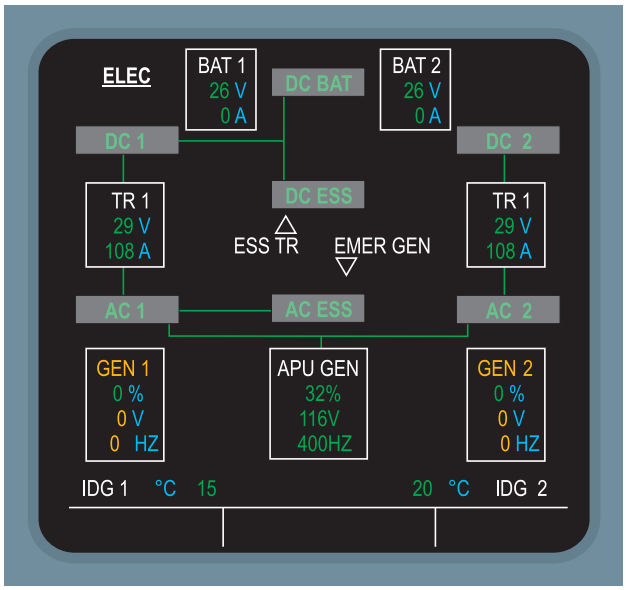
ECAM ELEC Page Displays

The graphics below display the ECAM ELEC page in the different normal operating configurations.

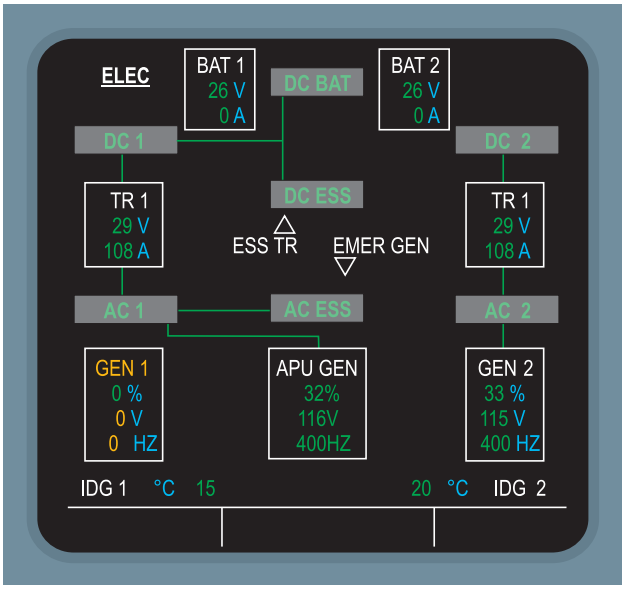
An item's normal configuration is depicted in green. The color amber depicts a malfunction or a depowered state.



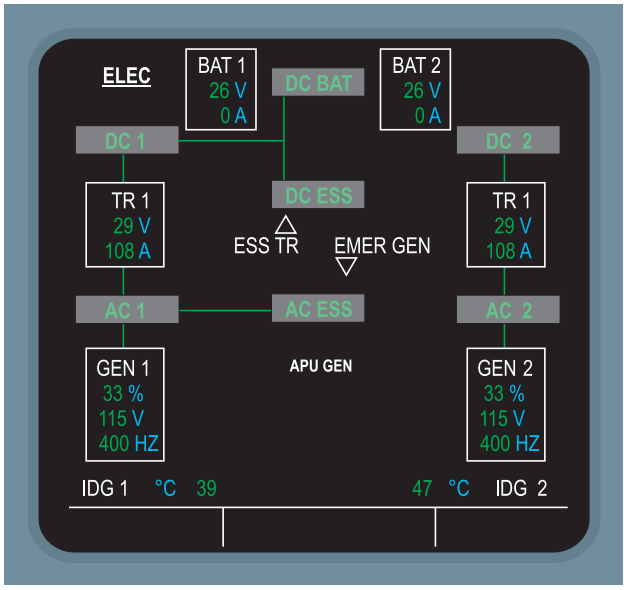
External Power In Use



APU GEN In Use



APU GEN and Engine GEN 2 In Use



Both Engine Generators In Use

F240118C

ECAM ELEC Page (continued)

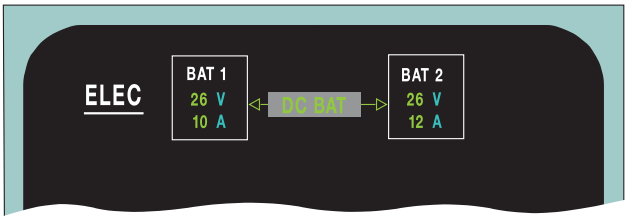
Battery Charge/ Discharge Indications

Battery charging and discharging indications are depicted by a green arrow on the ECAM ELEC page.

Battery Charging:

Battery charging indication is depicted as a green arrow pointing towards the battery from the DC BAT Bus.

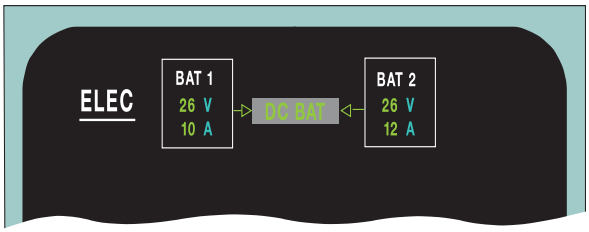
Note: Batteries charge independently of one another as controlled by their BCLs.



FG24027C

Battery Discharging:

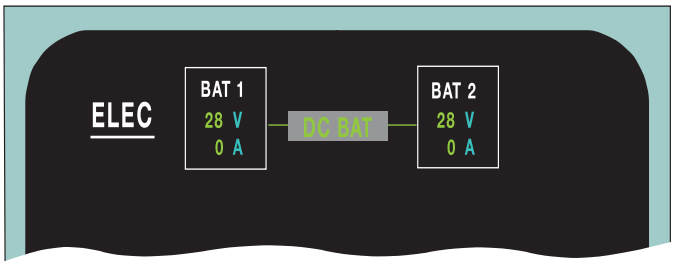
Battery discharging indication is depicted by a green arrow pointing towards the DC BAT Bus from the battery.



FG24028C

Negligible Current:

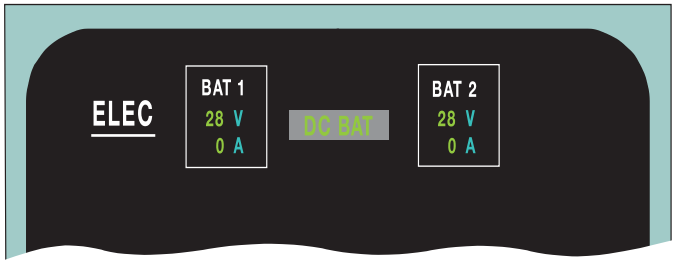
When the batteries are connect to the DC BAT BUS and the current flow is negligible, a green line without an arrow appears between the battery and the DC BAT Bus. The battery is neither charging nor discharging. This indication is normal and short in duration.



ECAM ELEC Page (continued)

No Activity:

When the batteries are not connected to the DC BAT Bus, the green line and arrow are not displayed.



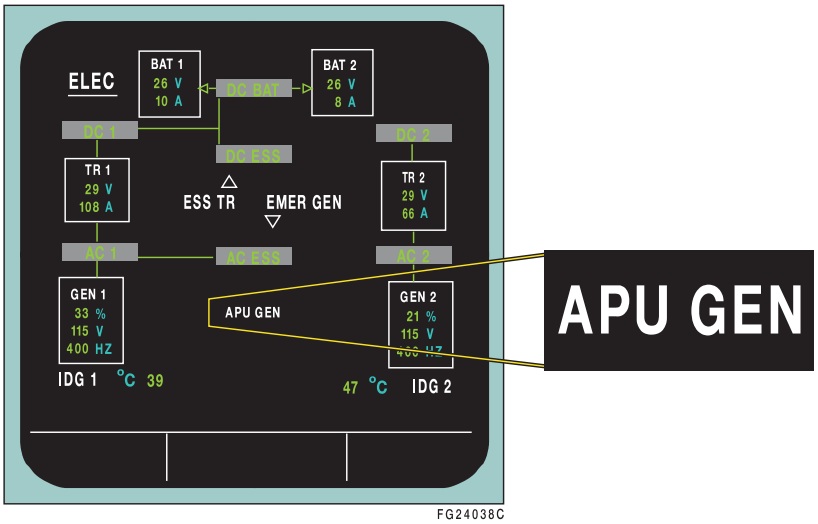
Bus Indications

Bus indications are normally green. If a bus is off or unpowered, its rectangular symbol and/or text will appear in amber.

The word SHED will only appear when the respective AC or DC ESS SHED bus is depowered.

APU GEN Indication

When the APU MASTER switch is selected off (Light out), the words APU GEN appear white without regard to the position of the APU GEN pb.



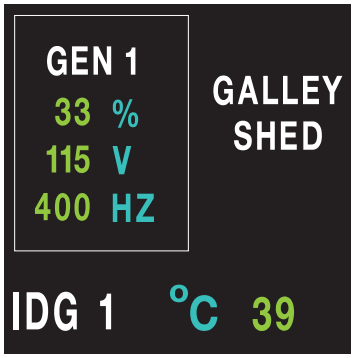
ECAM ELEC Page (continued)

GALLEY SHED Indication

GALLEY SHED indicates one of two conditions:

- both galley buses are depowered by selecting the GALLEY pb to OFF
- only the main galley bus is depowered (Partial Shed), e.g., one generator is powering the aircraft in flight

Note: GALLEY SHED only appears on the ECAM ELEC page.



Chapter 25: Equipment/Furnishings

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Controls and Indicators 25.20.1
Pushbutton (pb) Logic 25.20.1

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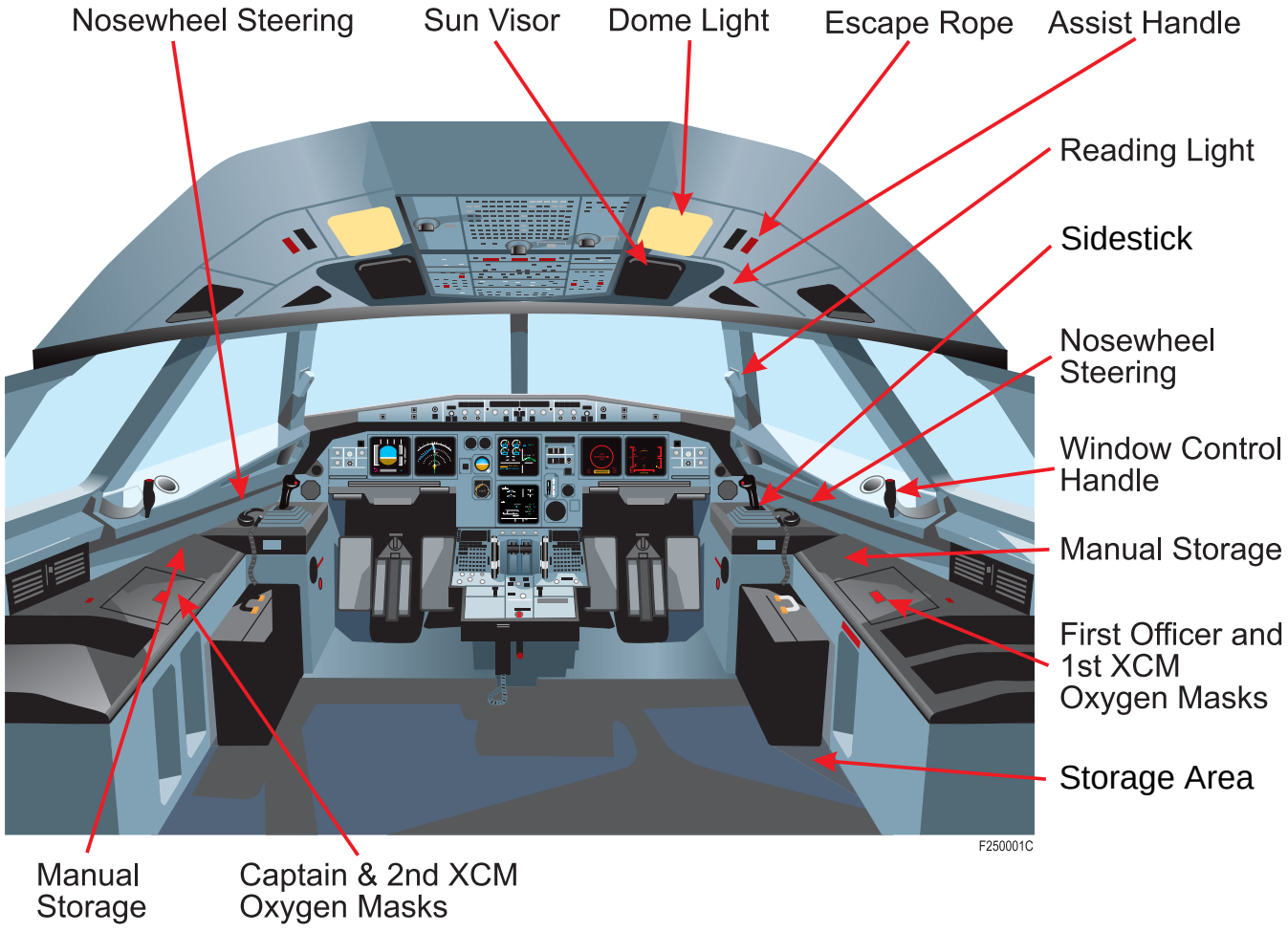
System Description

Flight Deck Overview

Description

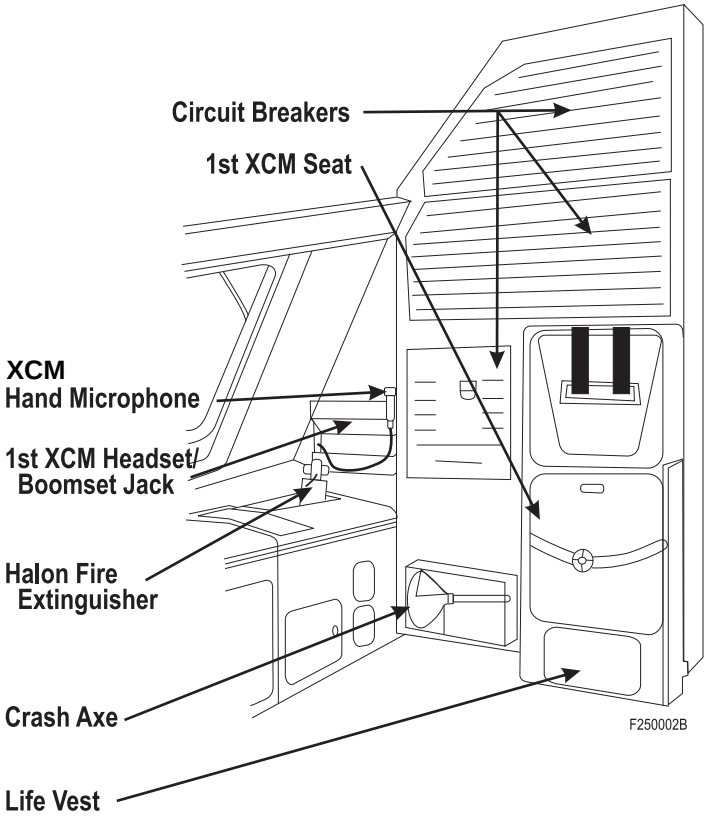
The A319/320 flight deck is arranged so that monitoring and control of the aircraft is easily performed by either pilot. Principle controls such as the landing gear lever, autopilots, thrust levers, and flap controls are found in typical locations. Pilot input to the flight controls, is accomplished with the movement of the sidestick controllers located near the pilots' armrests.

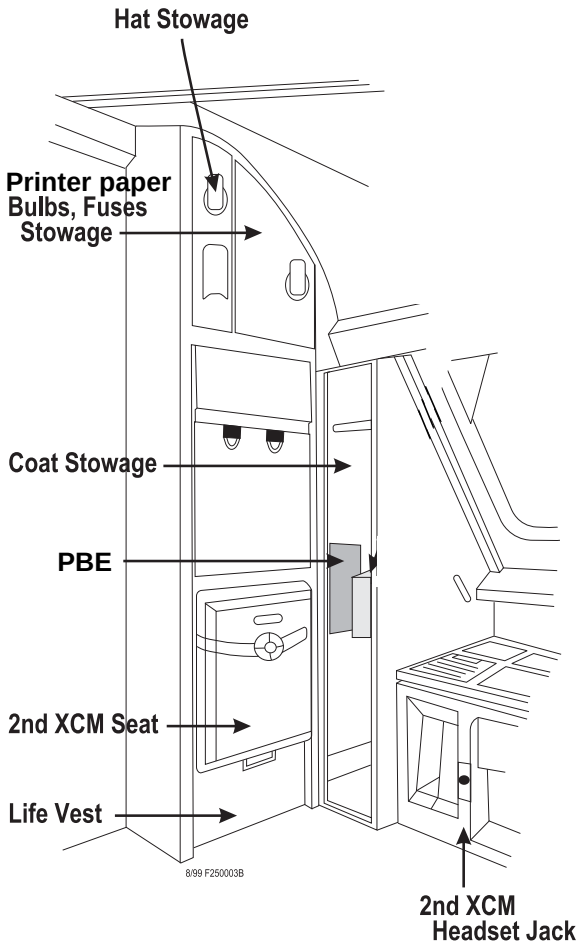
Flight Deck General Arrangement - Front



Flight Deck Overview (continued)

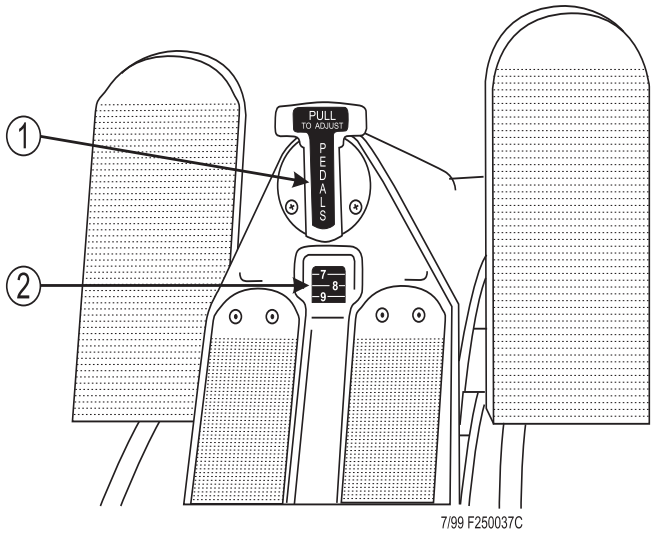
General Arrangement - Rear





Rudder Pedals

Description



1 Adjustment

A control lever is located between the rudder pedals. When pulled, the control lever unlocks the spring loaded rudder pedals for adjustment. When the lever is released, it locks the rudder pedals in place.

Note: Instead of a lever, some aircraft are equipped with a traditional crank that, when rotated, turns to adjust the rudder pedals.

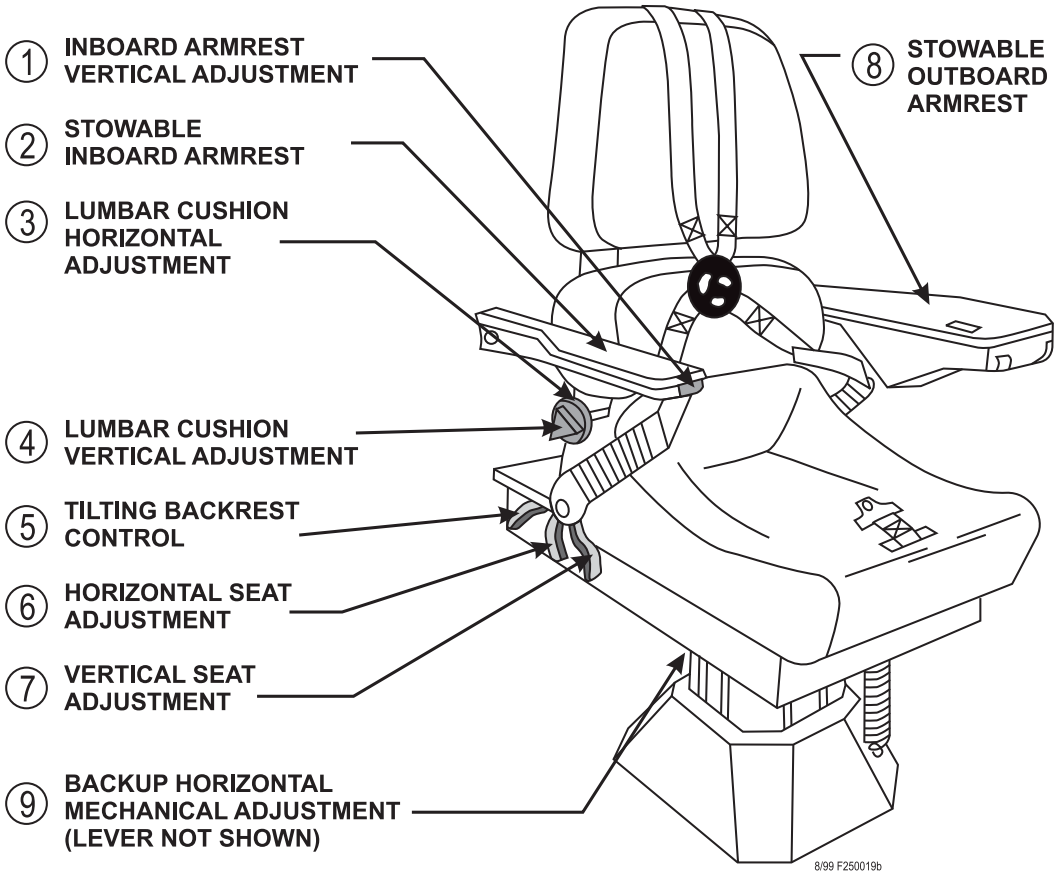
2 Position Indicator

A rudder pedal position indicator displays a numeric value which identifies the rudder pedal position and allows the pilot to set a consistent rudder pedal position from aircraft to aircraft.

Crew Member Seats

Crew Member Seat

The equipment available on the crew member seats is highlighted in the following diagram.



Crew Member Seats (continued)

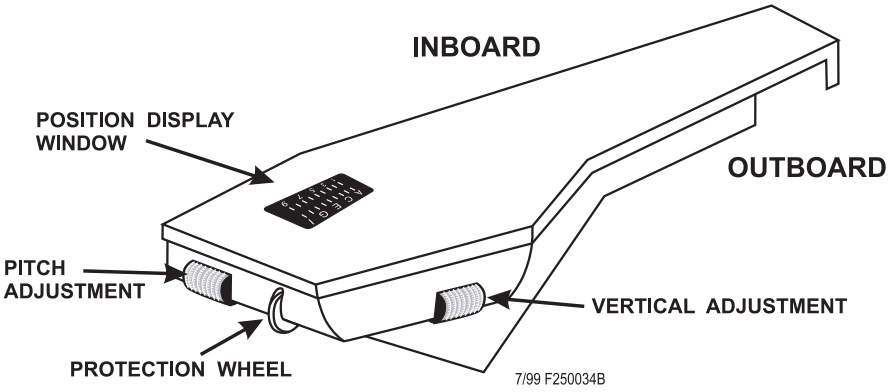
1 **Adjustment/ Inboard**	The inboard armrest can be vertically adjusted by movement of a control knob located on the front edge of the armrest.
2 **Armrests/ Inboard**	The inboard armrest is hinged to the backrest and can be lifted and stowed.
3 **Horizontal Adjustment/ Lumbar**	Turning the triangular knob allows lumbar cushion movement in and out. When the knob is released, the lumbar cushion is locked in position.
4 **Vertical Adjustment/ Lumbar**	Pulling the round serrated knob out and rotating allows lumbar cushion movement up and down. When the knob is released, the lumbar cushion is locked in position.
5 **Backrest Tilt**	Lifting the handle unlocks the backrest and allows tilting forward and aft. Releasing the handle locks it in position.
6 **Horizontal Travel**	Pushing the handle forward unlocks the seat and allows movement forward and aft. Releasing the handle locks it in position. **Note:** At the full aft position, this lever allows the seat to move laterally outboard for easy access.
7 **Vertical Rise**	Lifting the handle unlocks the seat and allows movement up and down. Releasing the handle locks it in position.
8 **Armrests/ Outboard**	The outboard armrest is provided primarily to support the forearm while using the sidestick.
9 **Backup Horizontal Mechanical Adjustment**	Pulling the lever permits horizontal adjustment of the seat when the normal control is inoperative.

Crew Member Seats (continued)

Adjustment /Outboard

The outboard armrest is provided with two knurled knobs which allow adjustment of height and tilt.

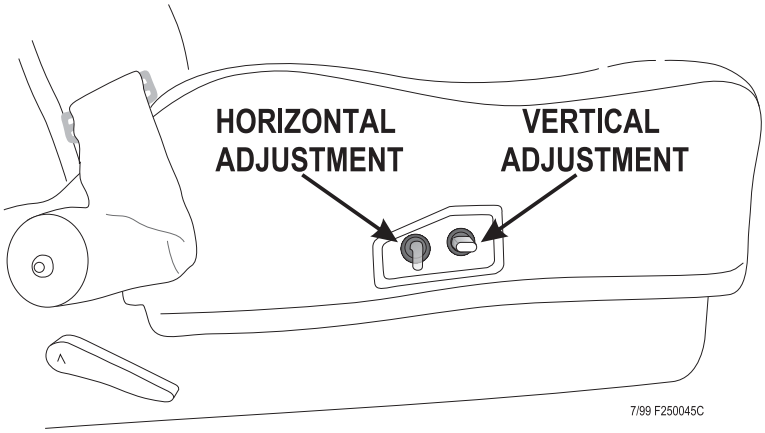
Note: The outboard armrest has a window which indicates pitch and height position to provide quick adjustment prior to each flight.



Horizontal and Vertical Travel (Electric Seat)

Electric seats have been installed on some aircraft. Horizontal and vertical travel is adjusted using the electric control switches. Manual adjustment handles are also installed for backup use. To adjust the electric seats, press the appropriate control switch in the desired direction and release it when the seat reaches the desired position. Backrest tilt must be adjusted using the manual adjustment handle.

Note: Due to MDM considerations, always use the electrical switches, if operable, when adjusting the electric seat.



Note: On electric seats, a circuit breaker is located on the underside of the seat, in the forward inboard corner.

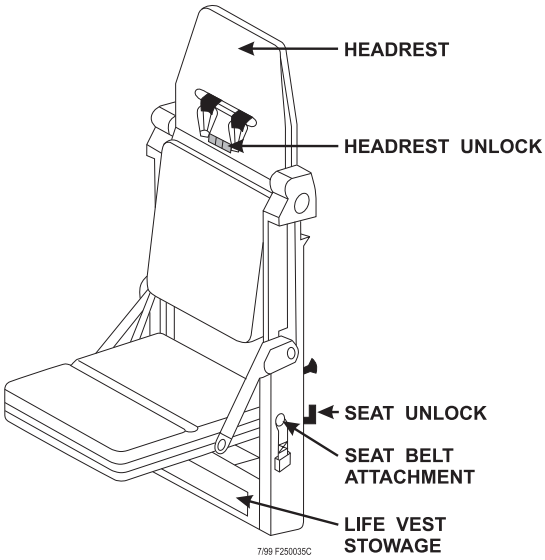
Note: An electric seat may be installed in A320 aircraft 3201-3250. These aircraft are not wired for electric seats and therefore the manual controls must be used. The electric feature of the seat will not be mco'd in this case.

Extra Crew Member Seats

1st XCM Seat

The 1st XCM headrest can be unfolded by raising it until it locks into place. The headrest can be stowed by squeezing the unlock clips together and folding the headrest down.

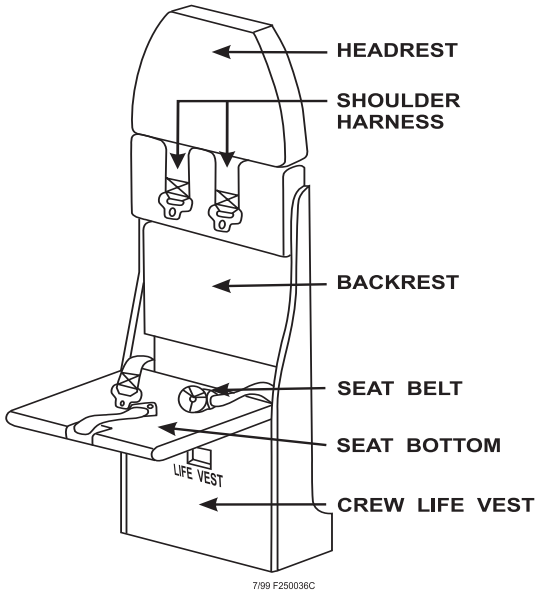
The seat bottom can be unfolded by pushing down on the spring loaded seat until it locks into place. The seat bottom can also be extended by raising the seat unlock lever and sliding the seat assembly sideways toward the flight deck centerline. Once the seat reaches its locked position, the seat bottom can be extended and locked. The seat bottom automatically folds up when the seat unlock lever is raised and the seat is slid toward its stowed position.



Note: The 1st XCM seat is provided with a headset and an Audio Control Panel (ACP).

2nd XCM Seat

The 2nd XCM seat is a stationary seat with a stowable seat bottom.



Sliding Tables

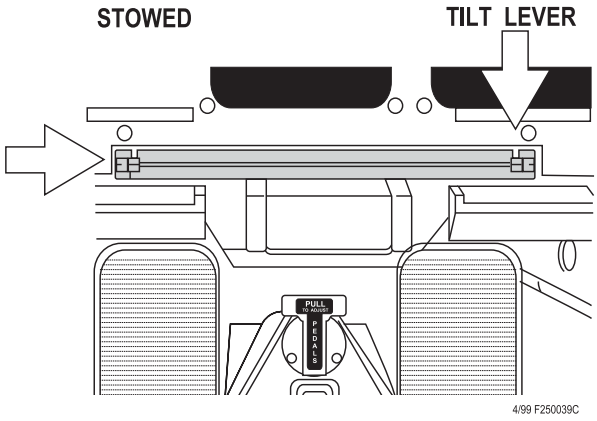
Operation

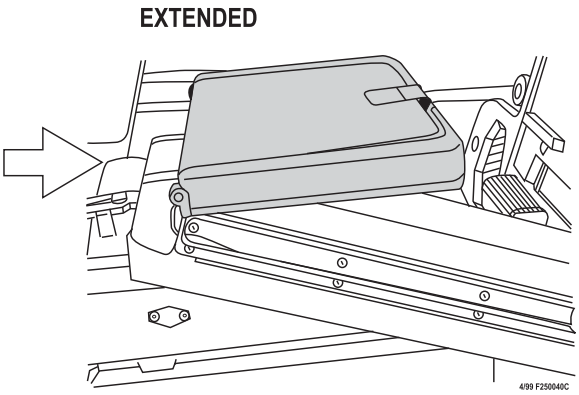
Sliding tables, located under each pilots' instrument panel can be extended, or stowed.

To extend the table, squeeze the control handle located on the underside of the table and pull aft. Once extended, a tilt control lever located on the right hand side allows table tilt. The table also unfolds for additional space. To stow the table, squeeze the control handle and push forward.

Note: To prevent damage to the clip, do not use it to hold thick objects. Do not extend the clip over chart binder rings.

Note: Do not stow the table with paper under the clip.





Controls and Indicators

Pushbutton (pb) Logic

Description

The pbs are designed to help the pilot make a quick determination of the status and configuration of the aircraft. Pbs are color-coded, grouped by system, and are incorporated into system schematics.

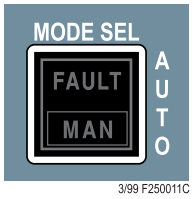
Some system pbs are non-latching. When the pb is pushed, an action occurs. The pb returns to a flush position when released. The following are some examples of pb logic.

ON

When a pb is depressed, it indicates that the system is ON.

AUTO/Lights Out

When a pb is depressed, it indicates that the system is in an automatic (lights out) mode.



3/99 F250011C

OPEN

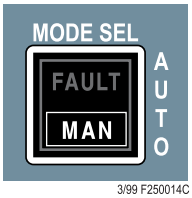
When a pb is depressed, it indicates that the corresponding valve has opened.

3/99 F250012C

OFF or MAN

When a pb is released, it indicates that the system is OFF, or in a manual (MAN) mode of operation.

3/99 F2500024C



3/99 F250014C

ALTN or OVRD

When a pb is released, it indicates that the system is being operated in an alternate (ALTN) or override (OVRD) mode of operation.

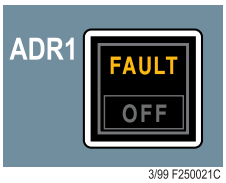
3/99 F250016C

3/99 F250015C

Pushbutton (pb) Logic (continued)

Color Code

There are color messages which illuminate on the pbs. The following table describes the color codes and provides examples for illustration.

Color Code	Indication	Example
Red Light	A failure has occurred or a situation has occurred which requires prompt action	
Amber Light	A failure has occurred which requires awareness but does not require prompt action	
Green Light	A system is available for use	
Blue Light	A system is being operated	
White Light	The pb is causing the system to operate in other than its normal lights out mode	

Note: Certain pbs have 2 dots indicating that the corresponding part of the pb is not used for system operation.

Note: Some pushbuttons only serve as lights. A dark border surrounding the light (e.g., see AFT SMOKE light) indicates that no switch functionality exists for this pb.

Chapter 26: Fire Protection

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- APU Fire Detection and Extinguishing 26.10.4
- Avionics Smoke Detection 26.10.6
- Avionics Smoke Removal 26.10.7
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- EMER ELEC PWR Panel 26.20.8
- CARGO SMOKE Panel 26.20.9

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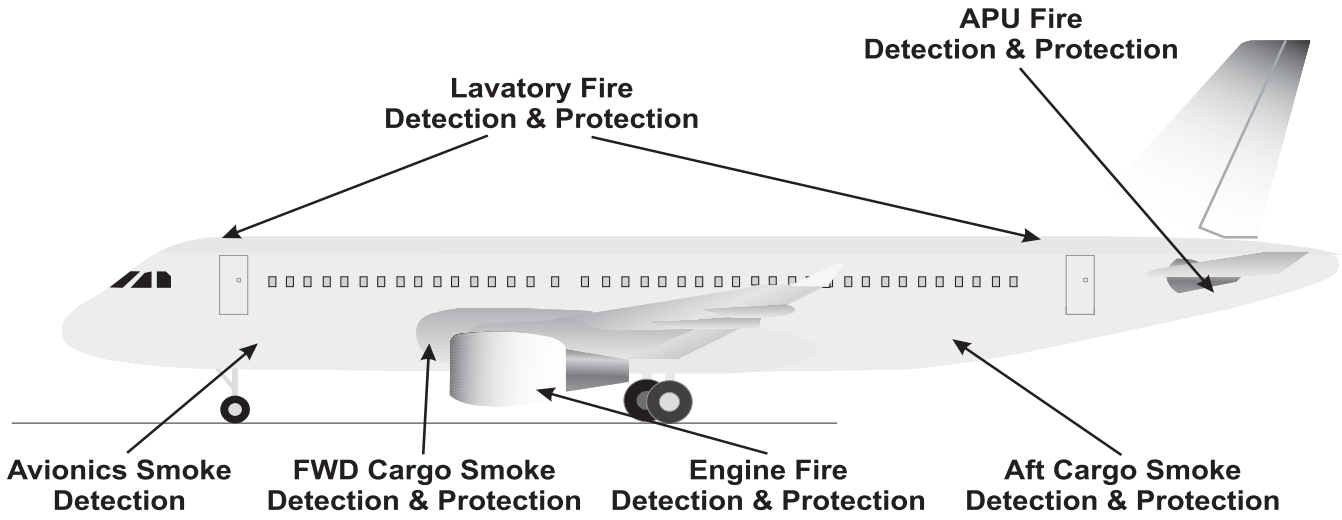
System Description

Location of Fire Detection and Protection System Components

Introduction

Several areas of the aircraft are provided with Fire Detection and Protection systems. These areas include:

- Engines
- APU
- Avionics Equipment Bay
- Forward and Aft Cargo Compartments
- Lavatories



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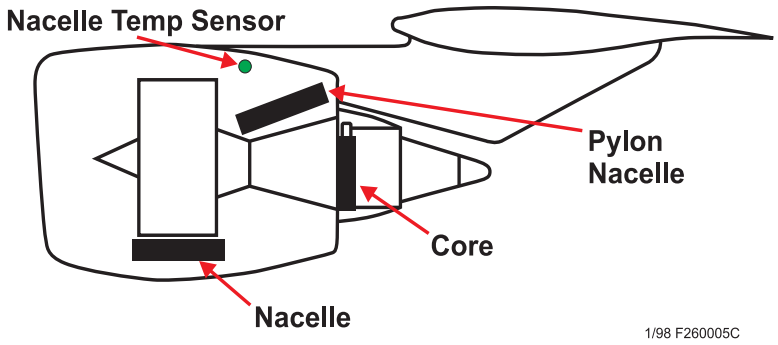
Engine Fire Detection and Protection

Description

Each engine is equipped with a fire detection system which consists of a Fire Detection Unit and two gas filled fire detection loops.

In addition, each engine has a Nacelle Temperature Sensor which provides nacelle temperature advisories.

Fire Detection Elements



Fire Detection Unit

Each engine's Fire Detection Unit (FDU) receives temperature input from its respective engine's Fire Detection Loops A and B. When the sensed temperature exceeds a preset limit, the FDU triggers an engine fire warning. In the event of a FDU failure, an ECAM message ENG 1 or 2 FIRE DET FAULT appears.

Fire Detection Loops

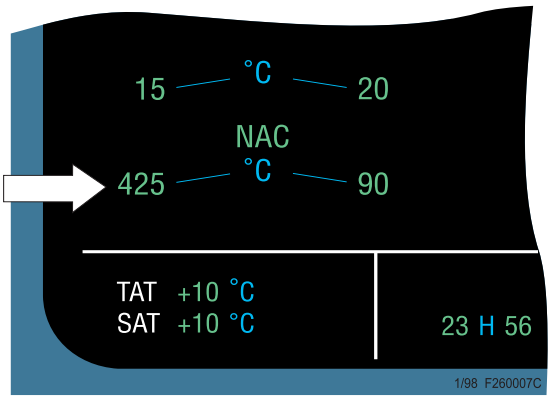
Two fire detection loops are positioned at critical locations on the engine to include the Fan Nacelle, Core and Pylon areas. In the event of a single loop failure, the ECAM message ENG 1 or 2 LOOP FAULT appears.

Note: The failure of one loop will not affect the operation of the other. However, an engine fire warning will occur if both Fire Detection Loops fail remove within 5 seconds of each other.

Engine Nacelle Temperature Sensor

The Engine Nacelle Temperature sensor is designed to provide an advisory indication only when the engine's nacelle internal temperature has reached a preset limit. The advisory is presented as a pulsating temperature value on the Engine ECAM page.

Note: The nacelle temperature sensor is not connected to the Fire Detection Unit and, will not generate an engine fire warning.

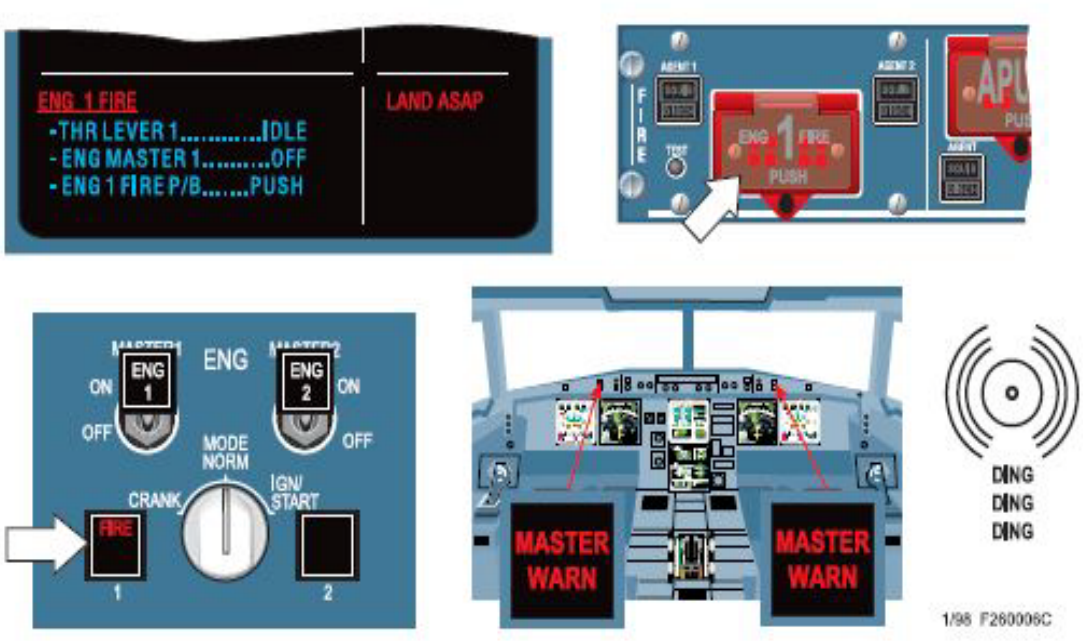


Engine Fire Detection and Extinguishing (continued)

Engine Fire Warning Indications

If an engine fire is detected, the following indications will be displayed in the flight deck:

- a Continuous Repetitive Chime (CRC) and the MASTER WARN lights illuminate
- the E/WD displays the ENG 1 (2) FIRE warning and a checklist
- the SD displays the ENGINE page
- the FIRE annunciator adjacent to the ENG 1 (2) master switch illuminates
- the ENG 1 (2) FIRE pb illuminates



Extinguishing

Each engine fire extinguishing system provides the flight crew with the means to extinguish an engine fire. Each engine fire extinguishing system consists of two halon-filled fire bottles located in the engine pylon.

If an engine fire warning occurs, the ECAM will provide a checklist for engine shutdown and fire extinguishing. The ECAM checklist may provide a countdown “clock” for bottle discharge. The countdowns are provided to enhance the effectiveness of the fire agents, but do not affect or inhibit the operation of the squibs.

Lifting the FIRE pb guard allows the pb to be released. Deselecting the FIRE pb arms both squibs. The halon fire bottle will discharge when the corresponding AGENT pb is selected.

APU Fire Detection and Extinguishing

Description

The APU is equipped with a fire detection system which consists of a Fire Detection Unit and two gas-filled Fire Detection Loops.

Fire Detection

If either loop senses a high temperature, a signal is sent to the APU Fire Detection Unit which determines whether or not a fire exists. The APU Fire Detection Unit will activate a warning if any of the following occurs:

- both loops detect fire
- one loop detects fire and the other loop is faulted
- both Fire Detection Loops fail with 5 seconds of each other

Indications

If the APU Fire Detection Unit senses a fire, the following indications occur in the flight deck:

- a Continuous Repetitive Chime sounds and the MASTER WARN lights illuminate,
- the E/WD displays a red APU FIRE warning and a checklist
- the SD displays the APU page
- on the FIRE panel, the red APU FIRE pb illuminates

Note: An APU fire on the ground will cause an automatic discharge of the halon fire bottle. This results in illumination of the DISCH light on the APU AGENT pb. The SQUIB light will not illuminate.

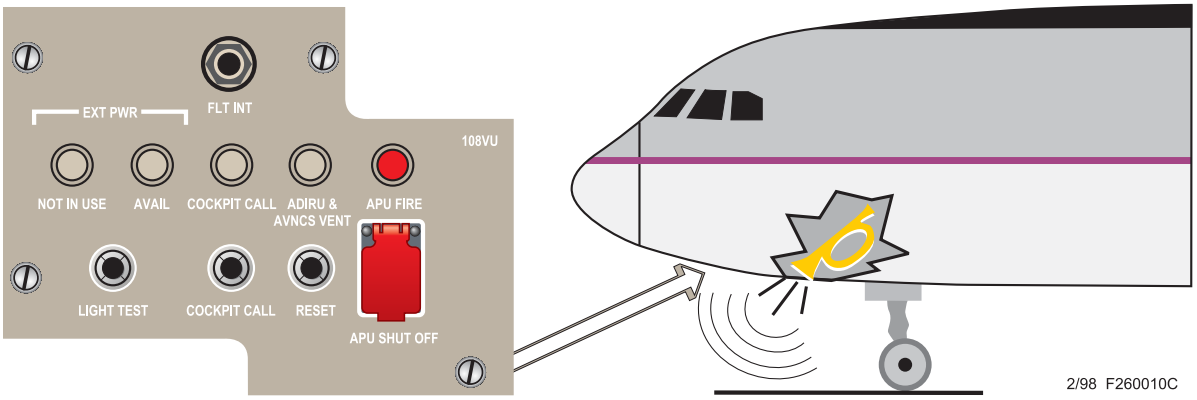
On battery power, the only warning is the red APU FIRE light in the APU FIRE pb.

APU Fire Detection and Extinguishing (continued)

Indications

On the ground, if an APU fire is detected the following indications occur externally at the service bay interphone panel located at the forward landing gear:

- the red APU FIRE light illuminates
- an external warning horn sounds



The horn can be silenced by releasing the flight deck APU FIRE pb or pressing the guarded APU SHUT OFF pb on the service bay interphone panel. The horn is automatically silenced when the APU fire is extinguished.

Extinguishing

On the ground, should the APU fire detection unit sense a fire, the APU will automatically shut down and the fire bottle is automatically discharged. However, in flight, the APU will not automatically shut down in the case of a fire. The pilot must manually shut down the APU and discharge the fire bottle.

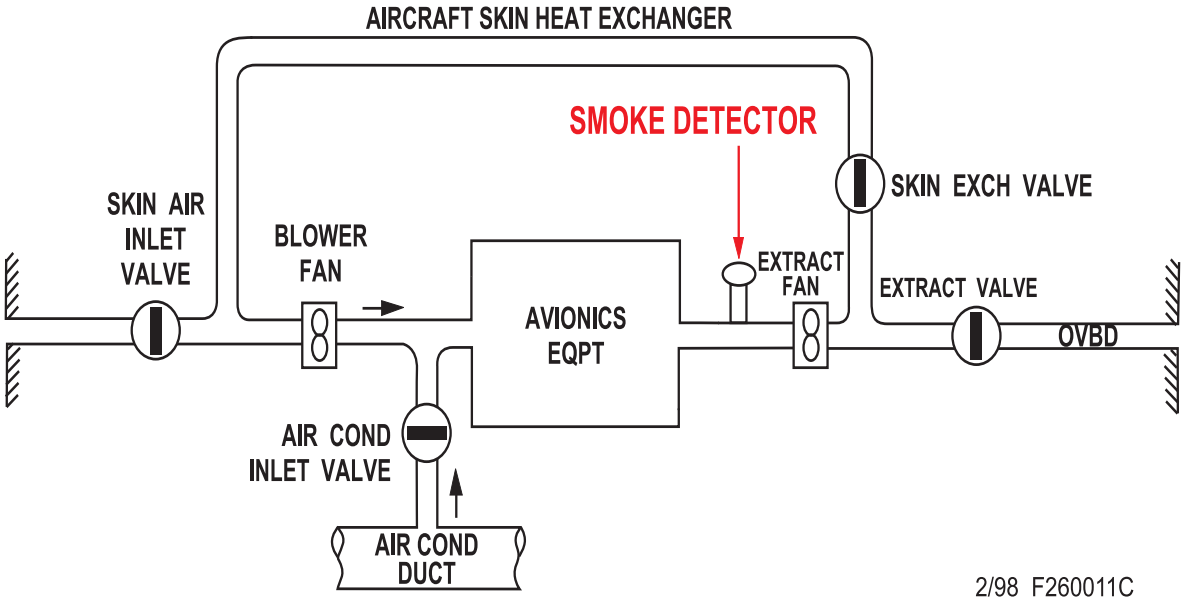
Note: When on the ground, with the APU operating as the sole source of electrical power, the aircraft batteries must be on in order to ensure a power source is available for fire bottle discharge in the event and APU fire is detected.

If an APU fire warning occurs, the ECAM (if powered) will provide a checklist for APU shutdown and fire extinguishing. Lifting the FIRE pb guard allows the pb to be deselected. Pressing and releasing the FIRE pb arms the squib. The halon fire bottle will discharge when the AGENT pb is selected.

Avionics Smoke Detection

Purpose

The avionics Smoke Detection Control Unit (SDCU) provides notification of smoke within the avionics ventilation system. The smoke detector is an ionization type detector that detects smoke particles, not heat.



The smoke detector is located prior to the extract fan in the avionics compartment ensuring that any smoke in the avionics compartment passes over the detector before exiting the compartment.

Indications

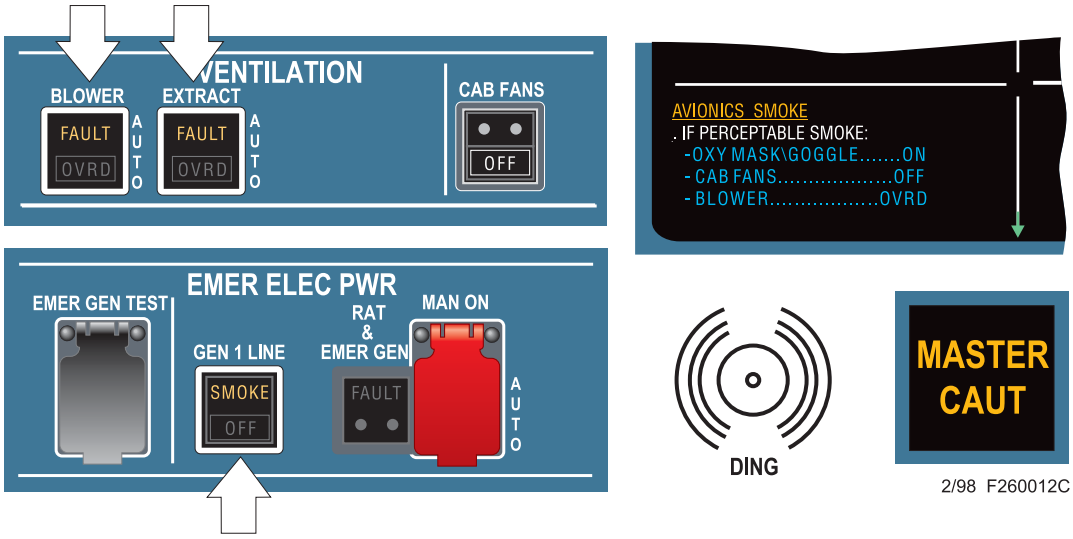
If the SDCU detects avionics smoke, the following indications occur:

- a single chime sounds and the MASTER CAUT lights illuminate
- the E/WD displays an amber “AVIONICS SMOKE” caution and a checklist
- the SD displays the ELEC page,
- an amber “SMOKE” light illuminates on the OVERHEAD EMER ELEC PWR panel, and
- on the VENTILATION panel, the amber “FAULT” light of the BLOWER and EXTRACT pbs illuminate.

Avionics Smoke Removal

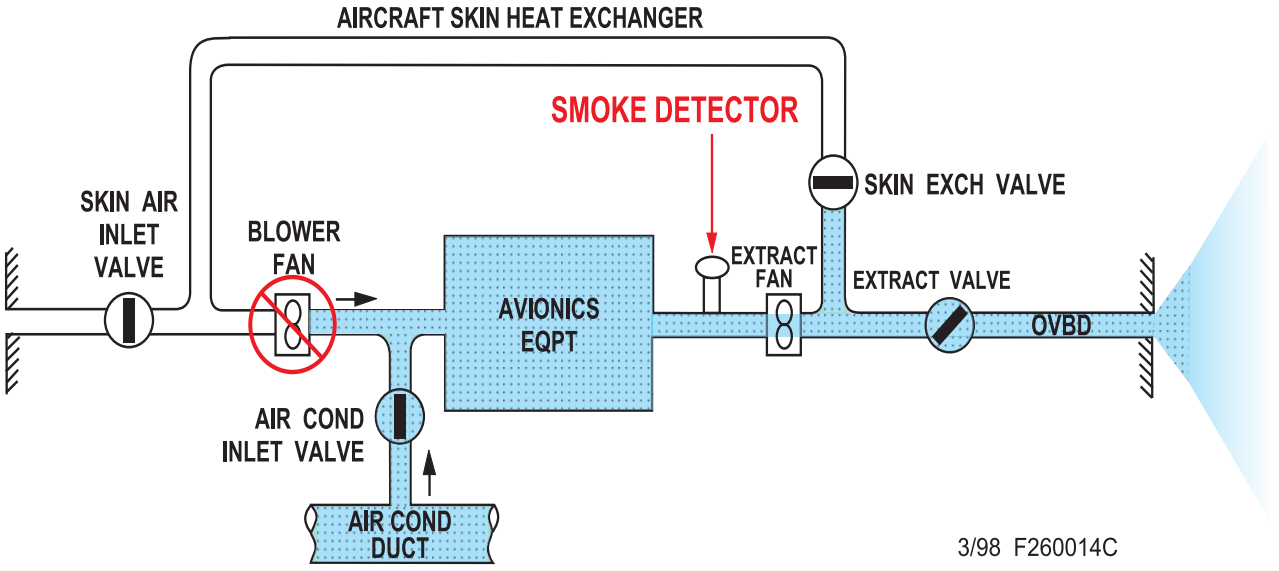
Operations

Smoke is removed by placing the BLOWER and EXTRACT pbs to OVRD (override).



This places the avionics ventilation system into the smoke configuration, in which:

- air conditioned air is added to provide ventilation to the avionics compartment,
- valves isolate the avionics compartment from the flight deck and cargo bays,
- a flap opens in the extract valve, allowing smoke to be exhausted overboard,
- the extract fan continues to run, extracting smoke from the compartment.



SMOKE CONFIGURATION

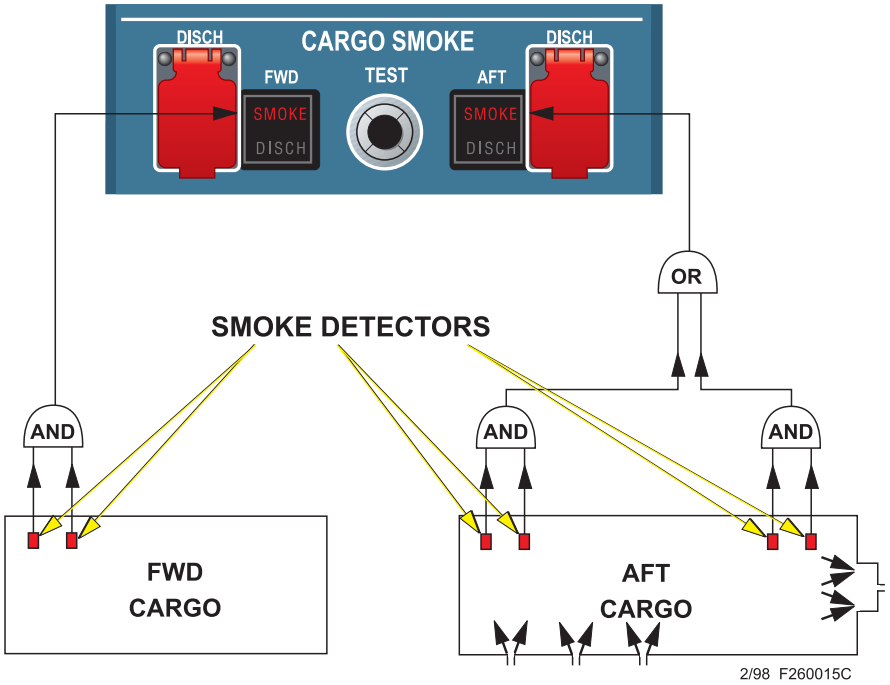
Cargo Smoke Detection and Extinguishing

Description

The forward and aft cargo compartments are equipped with dual channel smoke detectors. The compartments share a single fire bottle for fire extinguishing. Only the aft cargo compartment is ventilated. Detection of smoke in the aft cargo compartment automatically closes both aft compartment isolation valves, and stops the cargo extraction fan from running.

Smoke Detectors

Two smoke detectors are installed in ceiling cavities in both cargo compartments. The forward cargo compartment has one ceiling cavity with two smoke detectors. The aft cargo compartment has two ceiling cavities, each with two smoke detectors (total of four detectors). The smoke detectors are ionization type detectors that detect smoke particles, not heat.



Smoke in either a cargo compartment will generate a warning if:

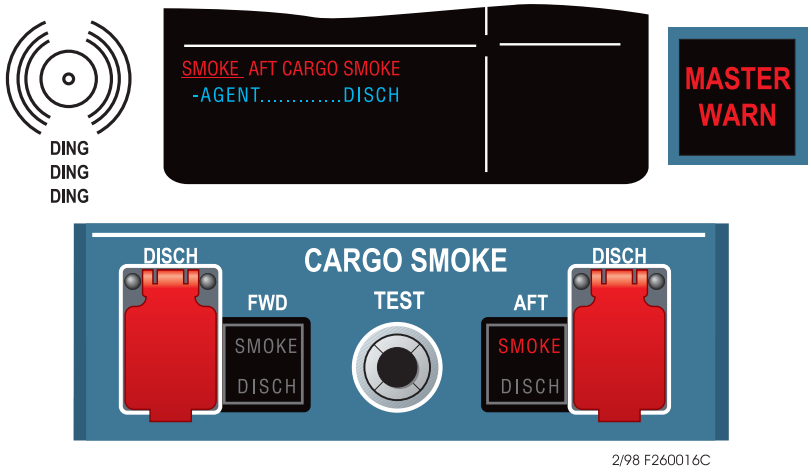
- both detectors in a ceiling cavity sense smoke or
- one smoke detector senses smoke and the other is inoperative.

Cargo Smoke Detection and Extinguishing (continued)

Indications (*continued*)

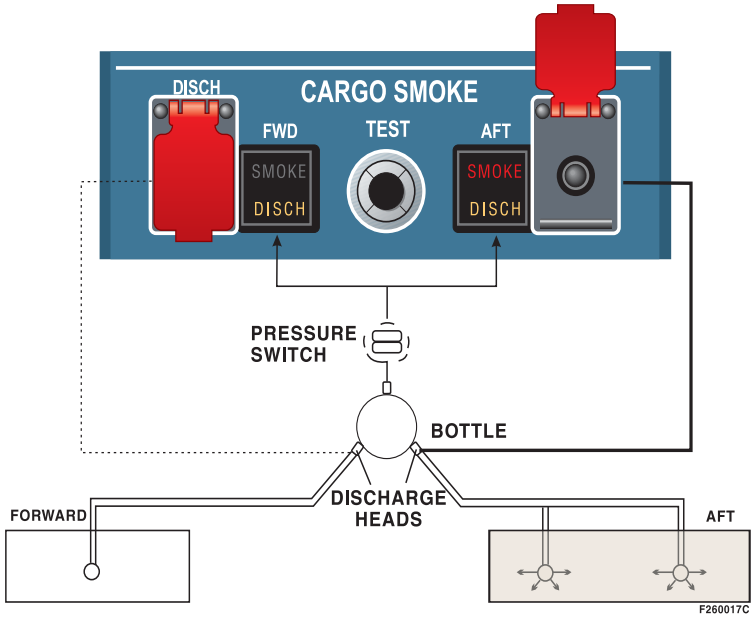
The following will be displayed if the Smoke Detection Control Unit senses cargo compartment smoke:

- a Continuous Repetitive Chime sounds and the MASTER WARN lights illuminate
- the E/WD displays a red SMOKE FWD (AFT) CARGO SMOKE warning checklist
- on the overhead CARGO SMOKE panel, the red “SMOKE” light illuminates in the corresponding indicator



Extinguishing

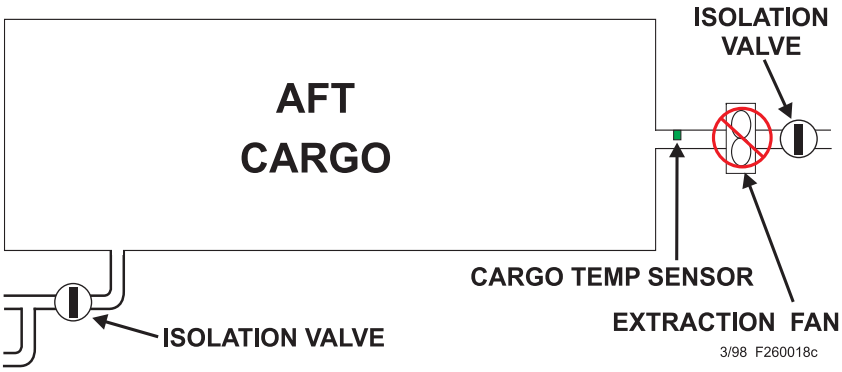
The cargo fire extinguishing system consists of one halon-filled fire bottle, shared by both compartments. The E/WD will provide a checklist to extinguish the fire. The pilot must manually discharge the fire bottle. An amber “DISCH” (discharge) indication is displayed in both cargo smoke pbs to indicate that the single bottle has been discharged. However, the agent is only dispensed into the selected compartment.



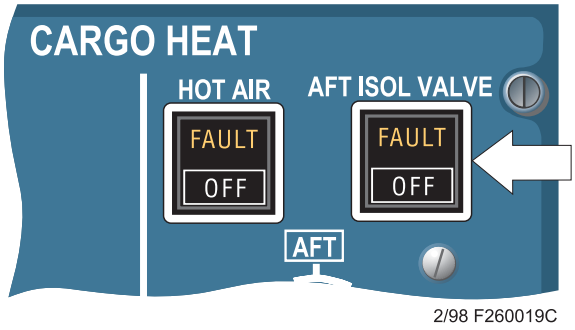
Cargo Smoke Detection and Extinguishing (continued)

Extinguishing

A smoke warning in the aft cargo compartment automatically closes the aft cargo isolation valves and the extract fan is commanded to stop.



The pilot can manually close the isolation valves by selecting the AFT ISOL VALVE pb to OFF.



With smoke and halon in the compartment, the red SMOKE light on the CARGO SMOKE panel will remain illuminated. The halon agent is designed to provide fire suppression for 45-60 minutes.

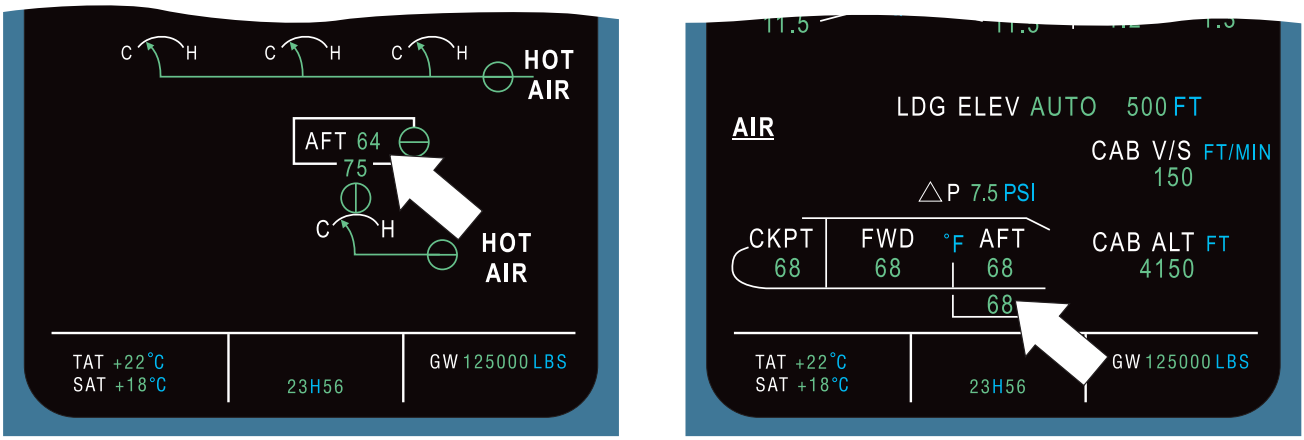
Warning:

Do not allow the cargo compartment to be opened until all passengers and crew have exited the aircraft, and fire services are in position ready to fight a fire. Opening a cargo door will introduce oxygen and a smoldering fire may reignite.

Cargo Smoke Detection and Extinguishing (continued)

Extinguishing (*continued*)

Additional information on the condition of the aft cargo compartment is available on the ECAM COND page or the ECAM CRUISE page to assist the flight crew in determining whether or not an aft cargo compartment fire has been extinguished.



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False Warnings

Due to the characteristics of the smoke detectors, operational experience has shown that two types of false cargo fire warnings can occur on the ground. If the cargo door is open on the ground, false warnings from ground equipment exhaust or other aircraft exhaust have been experienced. False warnings have also been experienced following deicing if the ground crew directed pressurized spray around a cargo compartment with degraded door seals. Both types of false warnings are rare. Refer to the QRH Cargo Smoke procedures for appropriate crew actions.

Lavatory Smoke Detection and Fire Protection

Description

The lavatory smoke detection system provides warning of smoke within a lavatory compartment. The smoke detector is located in the ventilation duct of each lavatory compartment. The ionization type smoke detector senses smoke particles, not heat. In some aircraft (refer to the MDM), the smoke detector is located in an area of the ventilation ducts that also require the operation of the LAV and GALLEY fans for smoke detection.

Indications

If the SDCU senses smoke in a lavatory the following indications occur:

- a Continuous Repetitive Chime sounds and the MASTER WARN lights illuminate
- the E/WD ECAM displays a red SMOKE LAVATORY SMOKE warning and a checklist,
- an amber light pulses next to the affected lavatory's door
- a lavatory smoke message is displayed on the flight attendant's call panel.

There is no indication in the cockpit to indicate which lavatory has detected smoke.

Flight Attendant Lavatory Smoke Message

If the lavatory smoke detector senses smoke in a lavatory, a message is displayed on the flight attendant's call panel. The lavatory with the smoke is identified with a letter, as follows:

- "A" indicating the first class lavatory.
- "D" indicating the aft left lavatory.
- "E" indicating the aft right lavatory.

Fire Extinguishing

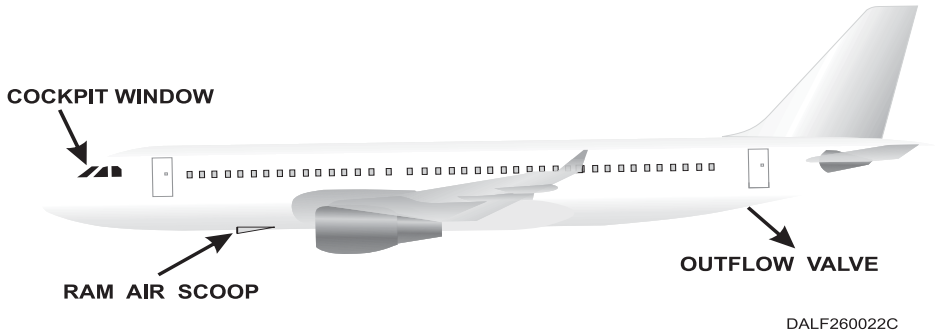
Each lavatory service cabinet trash bin (under the sink) contains a halon fire bottle. If there is a sudden temperature rise in the service cabinet, the agent in the halon fire bottle will discharge automatically. There are no cockpit or cabin annunciations that indicate the service cabinet halon fire bottle has discharged.

Cabin Smoke Removal

Description

There are no smoke detectors in the cockpit, galleys or passenger cabin. Therefore, the ECAM does not generate a checklist for cabin smoke. If a crew member discovers smoke, a QRH procedure will provide specific guidance on crew actions.

Smoke is removed from the cabin by depressurizing the cabin. The smoke is drawn out of the aircraft through the outflow valve at the rear of the cabin. Once the cabin is depressurized, the Ram Air pb can be used to provide fresh airflow. A cockpit window can be opened if necessary to provide additional airflow and smoke removal.



Note: In flight, the aft cargo compartment is ventilated with ambient cabin air. It is possible for smoke in the cabin to be drawn into the aft cargo compartment, resulting in a false aft cargo compartment smoke warning.

Cabin Smoke Removal (continued)

False Cabin Smoke Indications

Operational experience has identified a few characteristics that have been misidentified by the cabin crew as cabin smoke, resulting in unnecessary cabin crew alarm.

Cabin fogging has occurred during ground operations, takeoff, and during landing rollout. During hot and humid conditions, air conditioning system condensation may be visible coming from the cabin vents. During takeoff, the sudden addition of large quantities of cold air into a hot and humid cabin can cause cabin fogging for a short period of time (1-2 minutes). This can momentarily reduce visibility in the cabin significantly. This condition does not occur when the cabin has been adequately cooled prior to departure. No abnormal smell is associated with cabin condensation.

After the aircraft has been deiced, it is not unusual to smell deicing fluid for a few minutes after takeoff. Cabin fogging does not normally occur in this case.

During landing, a few cases of cabin fogging have occurred where cabin visibility has been suddenly reduced. These cases have been associated with landing on wet or contaminated runways. One possible cause appears to be the ingestion of deicing fluid from the runway during engine reversal.

Following passenger oxygen mask deployment due to cabin depressurization, the cabin crew can expect to smell a “dusty, ozone” type smell as a result of the passenger oxygen generator use. The oxygen generators create considerable heat, and the cabin temperature can be expected to rise significantly as a result.

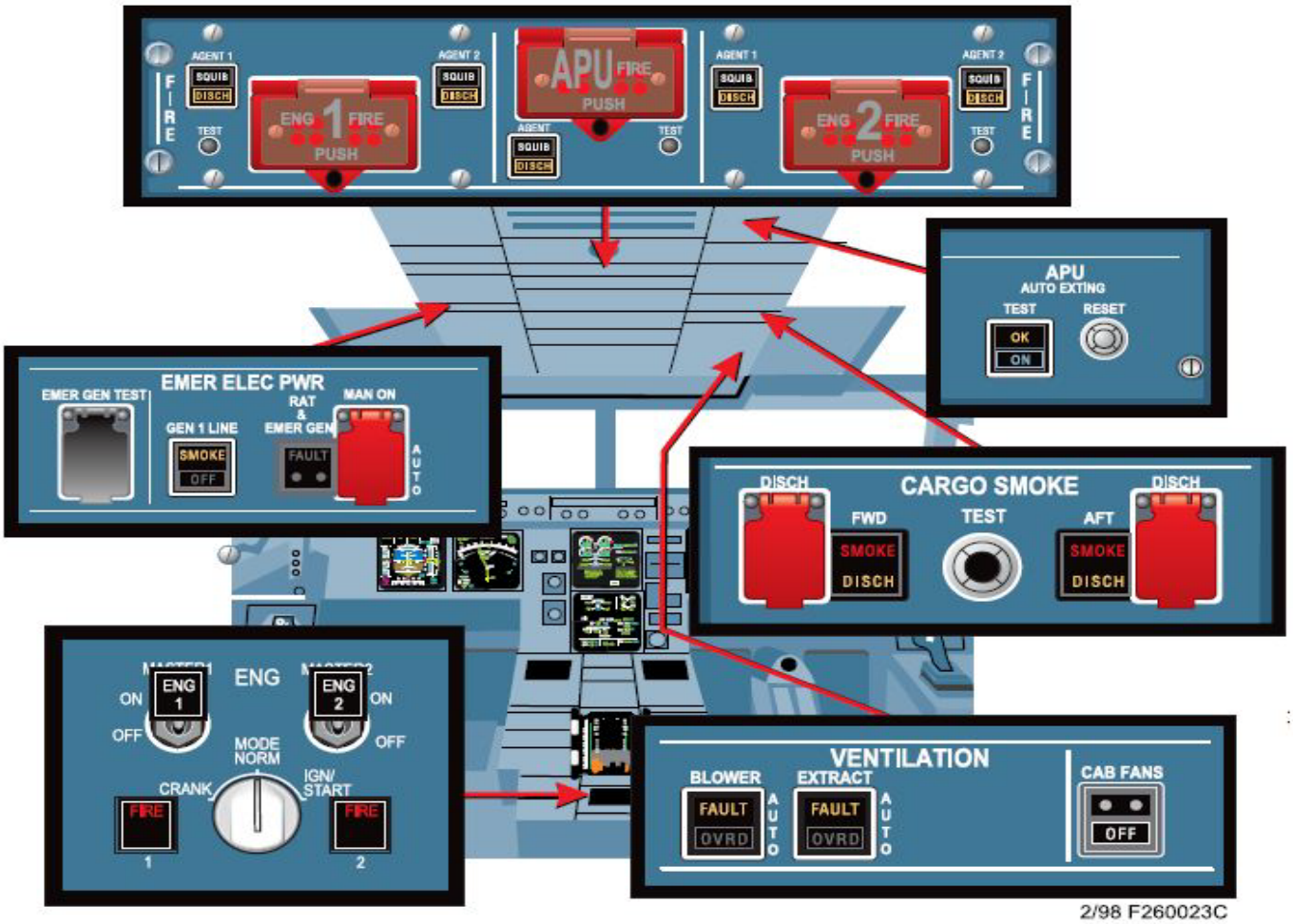
Controls and Indicators

Location of Controls and Indicators

Introduction

The fire protection controls and indicators are located:

- on the overhead panel,
- on the center pedestal, and
- on the service interphone panel at the nose landing gear.



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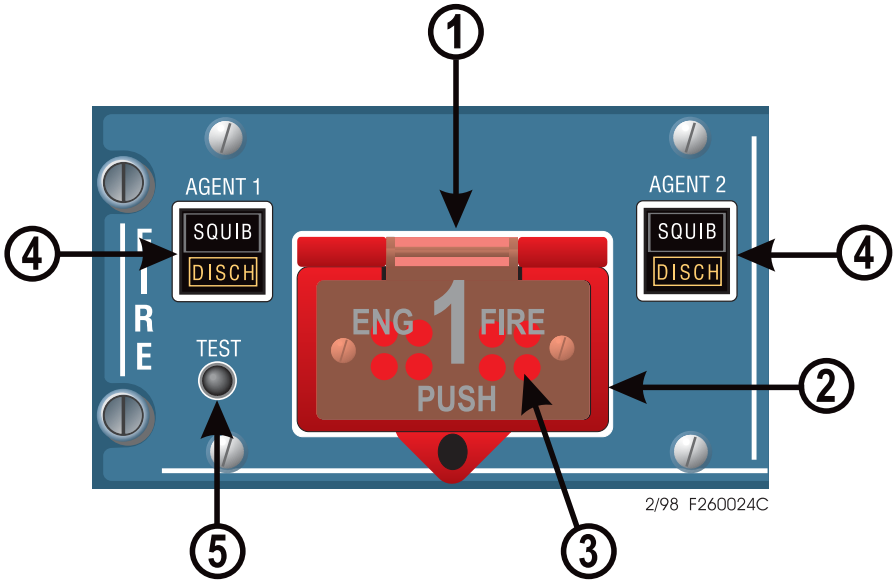
ENG FIRE Panel

Function

The ENG FIRE panel on the overhead panel provides indications and control for engine fire protection.



1 ENG 1 (2) FIRE pb

In and Guarded

This is the normal position.

Deselected Out

The following actions occur for the respective engine when the pb is deselected out:

- the aural warning is cancelled
- both squibs are armed
- the hydraulic fire valve closes
- the low pressure fuel valve closes
- the electrical generator comes offline
- the pack flow control valve is electrically signalled to close
- the engine bleed valve closes, and
- the FADEC is isolated from aircraft electrical power.

Note: If the engine is shutdown using only the engine FIRE pb, it may take up to one minute (at idle) for the engine to stop running as fuel is burned between the low pressure fuel valve and the engine.

2 Pb Guard

The guard protects the FIRE pb from inadvertent release. The guard must be lifted before the FIRE pb can be deselected.

3 ENG 1 (2) FIRE light

The light illuminates red when the respective Fire Detection Unit detects a fire. The light will extinguish when there is no longer a detectable fire.

ENG FIRE Panel (continued)

④ AGENT 1 (2) pb

The pb becomes armed when the corresponding ENG FIRE pb is deselected. When the pb is selected, the agent in the halon fire bottle is discharged.

SQUIB light

SQUIB illuminates white when the ENG FIRE pb is deselected to facilitate identification of the agent pb to be activated. On battery power or while in the emergency electrical configuration, only the number 1 agent is available and only the number 1 squib light will illuminate.

DISCH light

"DISCH" illuminates amber when the respective halon fire bottle is discharged. There are no indicators on the aircraft exterior to confirm the status of the engine fire extinguishing agent.

⑤ TEST pb

This pb enables the Fire Detection and Protection system integrity to be tested. When pressed, the following actions occur:

- a Continuous Repetitive Chime sounds and the MASTER WARN lights illuminate,
- on the overhead FIRE panel, the ENG FIRE pb illuminates red, the SQUIB lights illuminate white, and the DISCH lights illuminate amber
- on the ENG panel, the FIRE light illuminates red
- on the lower ECAM, the ENG page is displayed
- the E/WD displays a red ENGINE 1(2) warning and a checklist.

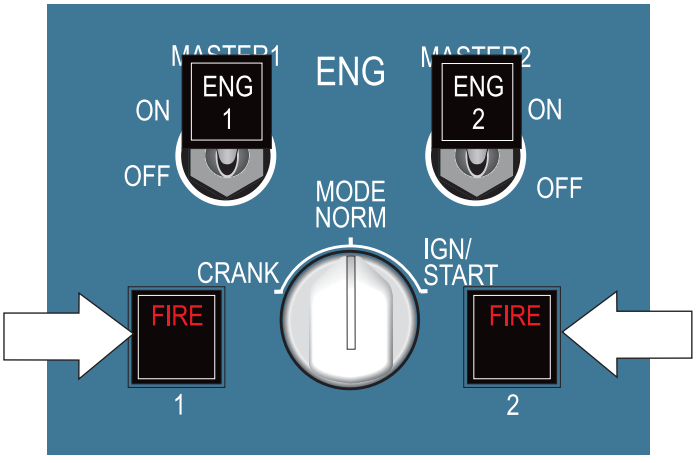
ENG Panel

FIRE light

A FIRE annunciation light is located adjacent to the ENG MASTER switch for each engine.

The FIRE light is a repeater of the overhead FIRE pb light and helps to identify the correct ENG MASTER switch to be selected OFF during an engine fire.

The ENG MASTER switch shuts off fuel to both the low pressure and high pressure fuel valves.



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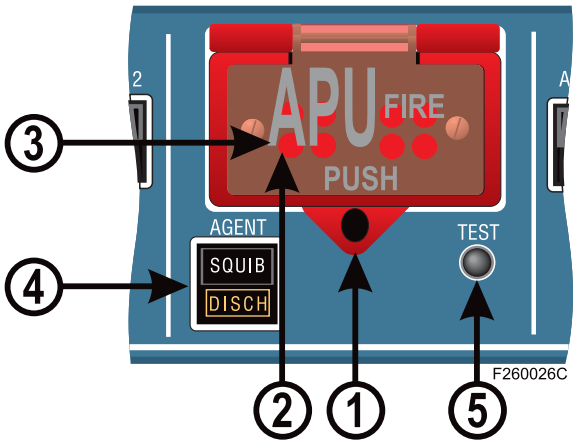
APU FIRE Panel

Function

APU FIRE controls are provided to extinguish a fire in the APU compartment. The APU FIRE controls are located between the engine fire control panels on the overhead panel.



1 Pb Guard

The guard protects the FIRE pb from being inadvertent deselected. The guard must be lifted before the FIRE pb can be deselected.

2 APU FIRE pb

In and Guarded

This is the normal position.

Deselect Out

When deselected out, the following actions occur:

- the APU automatically shuts down
- the cockpit aural warnings are cancelled
- the squib arms
- the low pressure fuel valve closes
- the APU fuel pump deactivates
- the APU bleed valve and the X-BLEED valve closes
- the APU generator deactivates
- the aircraft exterior warning horn is silenced.

3 APU FIRE light

The light illuminates red when the APU Fire Detection Unit detects an APU fire. The light will extinguish when there is no longer a detectable fire.

4 AGENT pb

The AGENT pb is armed when the APU FIRE pb is deselected. When the AGENT pb is selected, the agent in the halon fire bottle is discharged. The APU fire bottle will discharge even if only on battery power.

SQUIB light

“SQUIB” illuminates white when the APU FIRE pb is deselected.

DISCH light

“DISCH” illuminates amber when the halon fire bottle is depressurized.

APU FIRE Panel (continued)

(5) TEST pb

The pb enables the APU Fire Detection and Protection system to be tested. When pressed, the following actions occur:

- a Continuous Repetitive Chime sounds and the MASTER WARN lights illuminate
- the APU FIRE pb illuminates red, the SQUIB light illuminates white, and the DISCH light illuminates amber
- on the lower ECAM, the APU page is displayed
- the E/WD displays a red APU fire warning and a blue checklist.

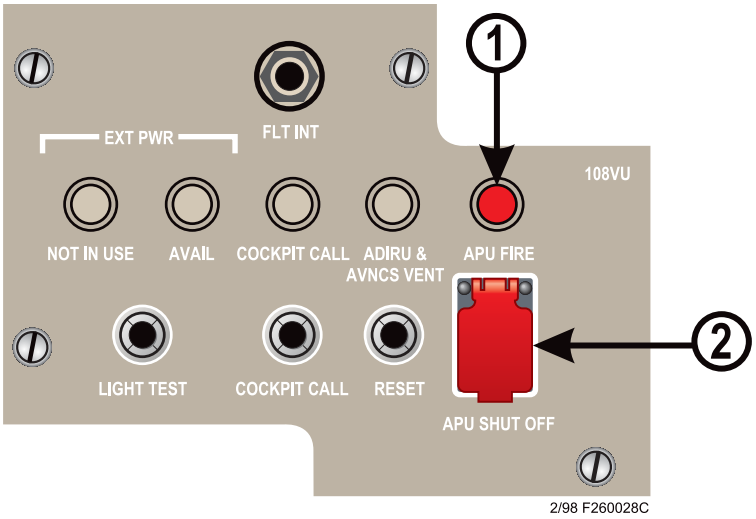
Automatic shutdown of the APU does not occur during the test.

If the APU fire test is performed on battery power, the only indications are the red APU FIRE light, the white SQUIB light, and the amber DISCH light.

Service Bay Interphone Panel

Function

The purpose of the APU FIRE light and APU SHUTOFF pb is to confirm an APU fire from outside the aircraft and silence the horn that sounds with a APU ground fire. The panel is located in the service interphone bay.



1 APU FIRE light

The APU FIRE light illuminates red when an APU fire is detected. The light is no longer illuminated when the fire has been extinguished.

2 APU SHUT OFF pb

An automatic shutdown occurs and the external horn is silenced when the cover is raised and the pb is selected.

APU Fire Bottle Discharge Indicator

Discharge Indicator

On the exterior of the airplane, a red disc is located on the left aft fuselage, adjacent to the APU air intake flap. If this disc is missing, the APU fire Protection agent may have depressurized and the APU fire Protection system is no longer available.

Avionics Smoke Removal

VENTILATION Panel

Function

Removal of smoke from the avionics bay is accomplished by reconfiguration of the ventilation fans and valves to redirect avionics air overboard. For more information on the ventilation system, refer to chapter 21, Air Conditioning.

BLOWER and EXTRACT pbs

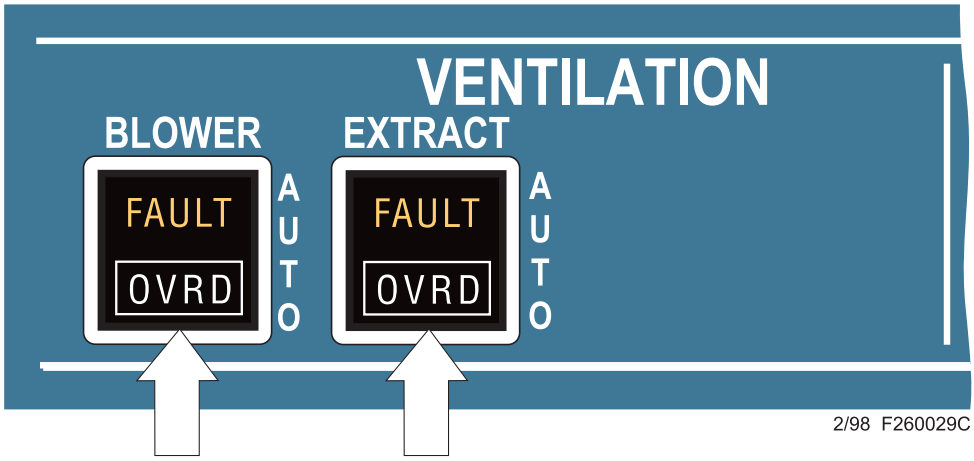
FAULT

Both FAULT lights illuminate amber when smoke is detected in the avionics ventilation duct.

OVRD

When OVRD is selected on one or both of the BLOWER and EXTRACT pbs, the avionics ventilation system is reconfigured to an alternate method of cooling. Selecting both pbs to OVRD results in the following:

- air conditioned air is added to provide ventilation of the avionics compartment,
- valves isolate the avionics compartment from the cockpit and cargo bays,
- a flap opens in the extract valve, allowing smoke to be exhausted overboard. The extract fan will continue to run, extracting the smoke from the avionics compartment.



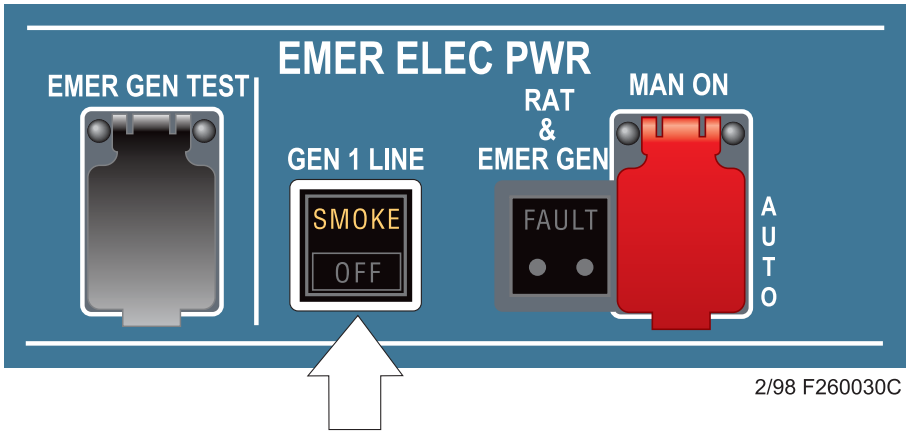
Avionics Smoke Removal (continued)

EMER ELEC PWR Panel

Function

The EMER ELECTRICAL PWR panel allows the pilot to selectively put the aircraft in the emergency electrical power configuration. Pbs on this panel enable the isolation of normal electrical power from the electrical system while still providing an electrical power source for the fuel pumps.

When electrical fire or smoke is suspected, separating electrical power and shedding all non-essential electrical equipment reduces a potential fire hazard.



GEN 1 LINE pb

SMOKE

SMOKE illuminates amber when smoke is detected in the avionics ventilation duct.

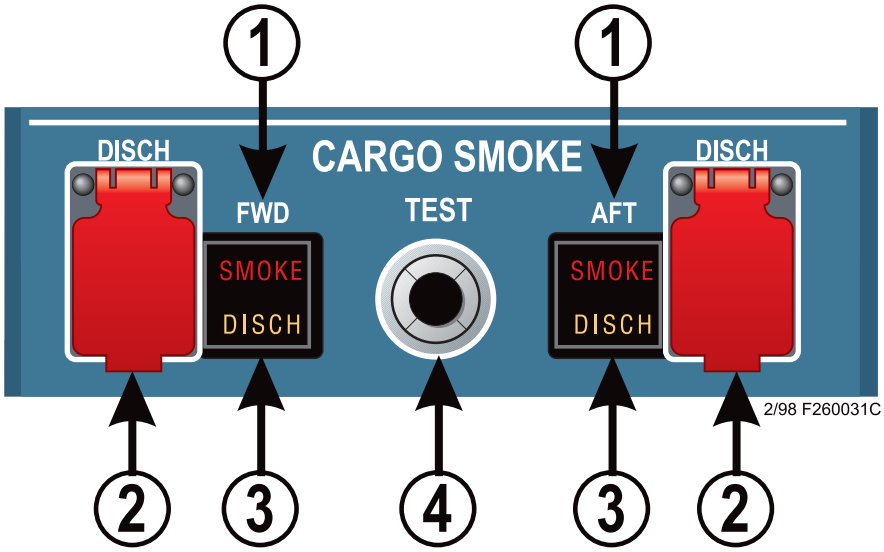
OFF

OFF indicates that the GEN 1 LINE pb has been selected OFF and the number 1 generator is disconnected from AC electrical bus 1. The number 1 generator continues to supply AC electrical power to one fuel pump in each main fuel tank. Refer to chapter 24, Electrical, for more information.

CARGO SMOKE Panel

Function

The CARGO SMOKE panel provides indications and control for forward and aft cargo compartment fires. This panel also provides a pb for testing the cargo Fire Detection and Protection systems. It is located on the right side of the overhead panel.



1 SMOKE light

The light illuminates red when smoke is detected in the corresponding compartment.

2 DISCH pb

When selected the agent is discharged into the corresponding cargo compartment.

3 DISCH light

Both lights illuminate amber when the agent has been discharged. However, the agent is only discharged into the selected compartment.

4 TEST pb

When pressed and held for approximately two seconds, the following actions occur:

- both red SMOKE lights illuminate, with associated ECAM messages
- both amber DISCH lights illuminate
- the CRC sounds
- the MASTER WARN lights illuminate.

The aural and visual warnings appear twice to indicate that both SDCU channels have been tested in sequence.

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Chapter 27: Flight Controls

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Fly-by-Wire Perspective

General

The Airbus fly-by-wire system provides natural and comfortable aircraft handling characteristics throughout the normal flight envelope. In the normal operating range, stick forces for a given roll or pitch rate are consistent regardless of airspeed. They do not become stiff and sensitive at high speeds nor soft at slow speeds. The automatic g-load, pitch, roll, airspeed, and angle of attack limiting features allow quick, maximum performance maneuvers when needed, such as GPWS-PULL UP terrain avoidance, with no danger of stalling or exceeding limits, in this case simply by pulling and holding full aft on the sidestick.

Handling Characteristics

There are certain differences, however, that must be kept in mind when hand flying the aircraft:

- In general, only light fingertip pressure is required to smoothly execute most hand flying. Remember, you are commanding a result (g load or roll rate) and not a flight control deflection. Due to the mass of the aircraft and other factors, there is some small delay between the stick input and when the resultant performance is achieved. Rapidly moving the stick, especially in large alternating direction motions is most likely to result only in pilot induced turbulence and difficulty flying the airplane precisely.
- In the landing phase many pilots tend to use larger control inputs than in higher speed phases of flight. Again, the roll and pitch rates are the same regardless of speed, so large inputs are usually counterproductive. In gusty or turbulent conditions, the aircraft is already trying to maintain a zero roll rate and is automatically making flight control deflections to do so, and it is doing so with no feedback to the sidestick. Pilot inputs other than those needed to correct the trajectory of the aircraft are usually unnecessary and likely to result only in pilot induced turbulence and difficulty flying the airplane precisely.

Neutral Dynamic Stability

The aircraft is extremely stable in both pitch and roll, so much so that it may easily give the impression that the autopilot is on, even when it is not. If the aircraft does not appear to be following flight director and FCU commands, it is likely that the autopilot is off.

Unlike an airplane with a conventional flight control system where a set pitch trim tends to maintain a particular airspeed, Airbus fly-by-wire aircraft maintain a steady g-load, which essentially equates to a constant pitch attitude, unless commanded otherwise. It is considered to exhibit neutral dynamic stability, not the positive speed stability that is characteristic of non fly-by-wire transport category aircraft, whereby the aircraft will tend to return to its trimmed airspeed. Therefore, in a situation such as after-takeoff thrust reduction, if pitch is not also reduced the aircraft will continue to maintain the same pitch attitude and airspeed will bleed off. Of course, the automatic protections prevent the aircraft from stalling by either selecting TOGA power when alpha floor engages or reducing pitch when alpha-prot is reached; however, at this point the aircraft will be significantly below the normal maneuvering speed for the current configuration.

Fly-by-Wire Perspective (continued)

Neutral Dynamic Stability (continued)

In another scenario, if a go-around is initiated with the autopilot off the aircraft will initially pitch up slightly as a result of the pitching moment from the rapidly accelerating, low hung engines. However, the pitch up is short lived and the aircraft will not attempt to maintain a trimmed airspeed as most conventional flight control aircraft would. Instead, the pitch up will be brief and the aircraft pitch will stabilize quickly causing the aircraft to rapidly accelerate, possibly resulting in a flap overspeed. Again, in this case the aircraft will not be following the flight directors, which will be commanding a further pitch up to the go around pitch attitude, providing one of several clues that the autopilot is not engaged, and pilot action is required. Situations which may result in this scenario include a failure of the ILS glideslope. In this case the autopilot will automatically disconnect when the glideslope is not regained within a few seconds of the failure. The master warning light will flash, an alert will sound, and an ECAM AUTOPILOT OFF message will be displayed, but experience tells us that even these obvious and noisy indications are easy to ignore when the workload is high. If the aircraft is not doing exactly what is expected, then the pilot must take immediate action.

Handling Differences

The flying of some maneuvers is significantly different and the flight control laws must be kept in mind when flying them.

For example, during crosswind landings if a slip is to be used just prior to landing, it is important to realize the control input differences from a conventional aircraft. While in a conventional control aircraft aileron needs to be held in as the rudder is applied, with the Airbus fly-by-wire flight controls, lateral stick input only needs to be made to establish the desired bank angle and then the stick must be returned to neutral to command zero roll rate. After the bank is established and the stick returned to neutral, the aircraft will automatically hold the aileron in when the opposite rudder is applied in order to maintain the bank angle. Failure to return the stick to neutral will command an continued roll rate and quickly result in excessive bank for the maneuver. Upon landing, when the flight controls revert to ground mode (direct law), the stick will have to be moved into the wind just to keep the aileron deflection the same, because in the ground mode the relationship between the stick and the flight control surfaces is the same as a conventional aircraft, neutral stick commands neutral aileron. Leaving the stick in neutral after the initial touchdown may result in the upwind wing rising, as it is equivalent to returning the control inputs to neutral upon touchdown in a conventional control airplane.

Summary

In summary, most pilots will find the fly by wire system quite pleasant to operate; however, you must keep in mind exactly what your sidestick movements are commanding. Keep sidestick movements deliberate and gentle, and if the aircraft is not following the flight director, the autopilot is probably off, and immediate pilot action is required.

System Description

General Description

Introduction

The majority of the flight control surfaces are conventional. Elevators and the Trimmable Horizontal Stabilizer (THS) control pitch, ailerons and spoilers control roll, and the rudder controls yaw. Leading edge slats and trailing edge flaps improve low-speed lift. On the ground, all of the spoiler panels are used as ground spoilers. In flight, some of these panels perform as speed brakes.

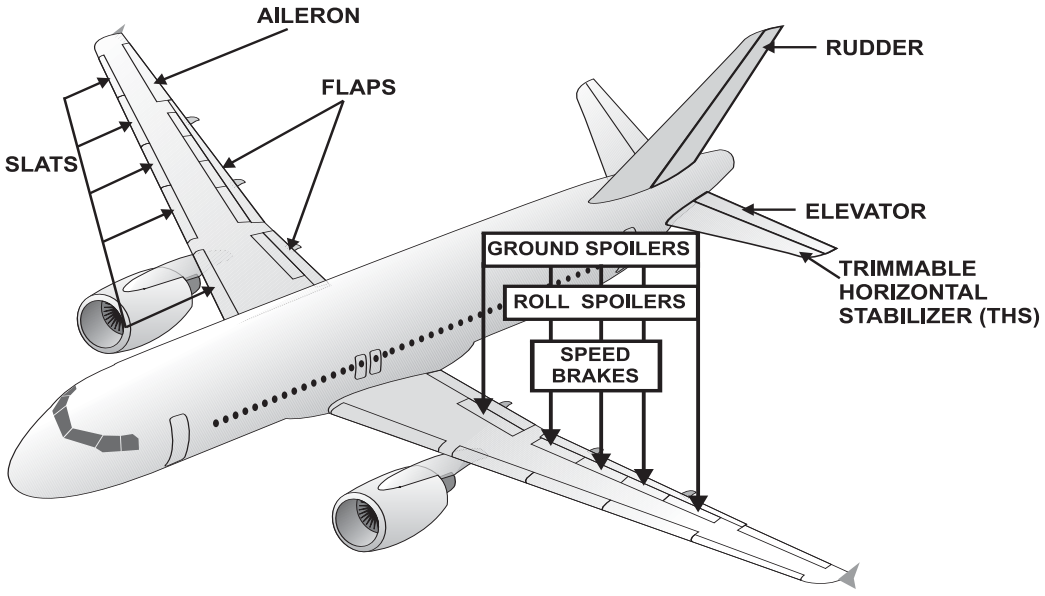
A sidestick and rudder pedals are used for normal aircraft control. Traditional control levers and handles exist for speed brakes and ground spoilers, flaps, manual pitch trim, and rudder trim

Note: Pitch trim is automatic, therefore, no pilot pitch trim input is required when the aircraft is hand flown.

Handling Characteristics

Pitch - Unlike an aircraft where a set pitch trim maintains an airspeed (e.g,speed stability), Airbus aircraft maintain a constant g-load (e.g., constant pitch attitude) unless commanded otherwise. Therefore, it is considered to exhibit neutral dynamic stability, i.e, if the pitch attitude is set at 10 degrees nose up rotation, the pitch remains at 10 degrees nose up.

Roll - Unlike an aircraft where a roll input commands a given aileron/spoiler deflection, Airbus aircraft maintain a roll rate for a given roll command. Therefore, for crosswind sideslip maneuver, the lateral stick input only needs to be made to establish the desired bank angle and then the stick must be returned to neutral to command zero roll rate. Failure to return the stick to neutral will command a continued roll rate resulting in an excessive bank.



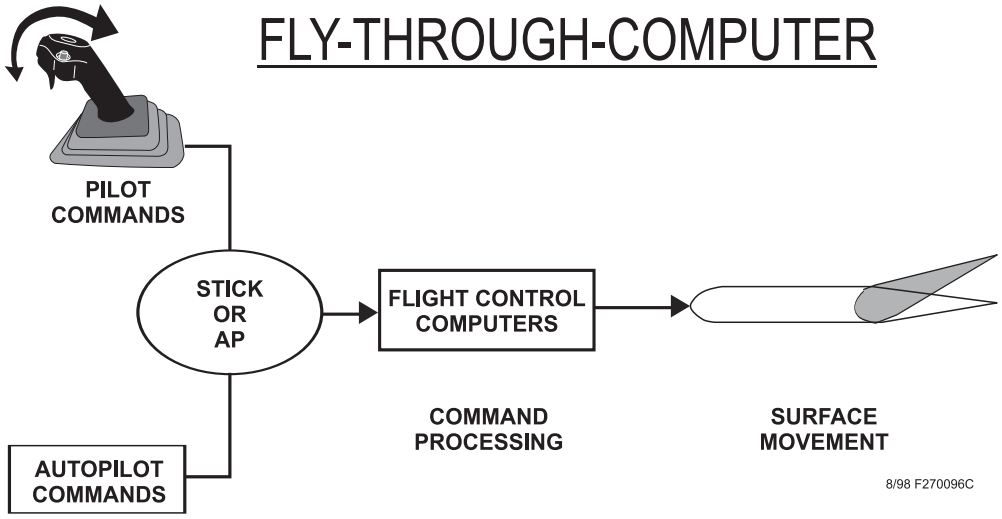
Normally, the flight control surfaces are electronically controlled and hydraulically actuated. For redundancy, some of the surfaces have back-up mechanical controls. However, when utilizing these back-up mechanical controls, hydraulic power is required to move the flight control surfaces.

Fly-Through-Computer

Description

Fly-through-computer is an enhancement and improvement to basic fly-by-wire control systems. Fly-through-computer takes pilot stick and rudder commands and routes those commands through one or more flight control computers. These processed electronic commands are then sent to the appropriate flight control surface's hydraulic servos, thus producing flight control surface movement.

The same basic process occurs whether the control command is produced by a pilot or an autopilot. Pilot or autopilot produced control commands use the same flight control computers and flight control servos. There are no dedicated autopilot servos. For simplicity, most of the following graphics will show only a sidestick as the originator of a control command. However, an autopilot produced command would have identical results.



Advantages

A fly-through-computer system has many advantages over earlier designs. During normal operations:

- A pilot sidestick input in pitch or roll results in the same aircraft response, regardless of airspeed, altitude, aircraft configuration or weight.
- The flight control system automatically compensates for failures. For example, if one aileron is inoperative, the flight control system automatically compensates by using spoilers to achieve the commanded roll rate.
- The flight control system monitors the performance of all components and provides notification of failures. Every component has at least one backup, and a single failure of any computer or hydraulic system will have little or no impact on the operation of the aircraft.
- The flight envelope is automatically protected, (e.g., Minimum and maximum speeds, maximum bank angles, pitch angles, etc., are automatically limited).

Flight Control Computers

Description

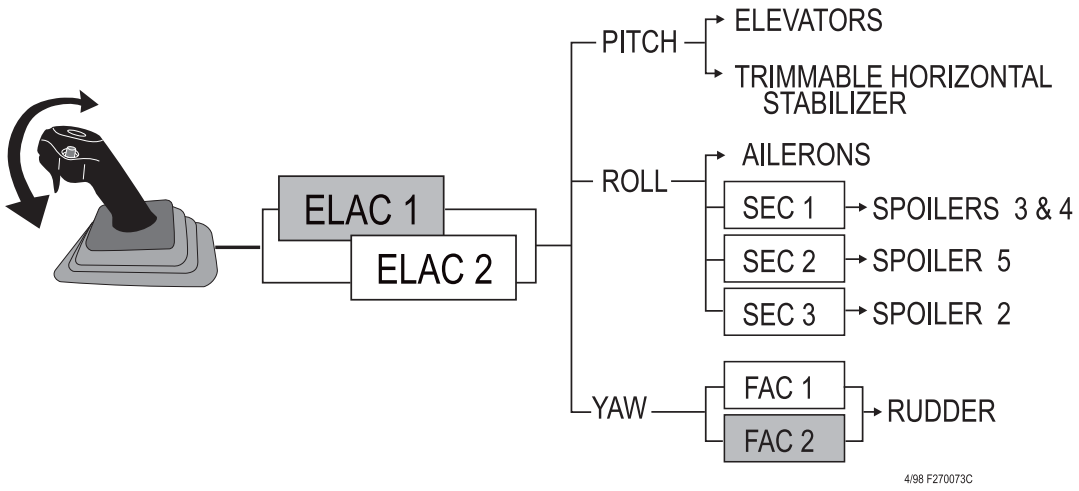
The flight control system consists of seven flight control computers;

- Two Elevator Aileron Computers (ELACs)
- Three Spoiler Elevator Computers (SECs)
- Two Flight Augmentation Computers (FACs)

Contained within the flight control computers are factory preset instructions and limitations called flight control laws (discussed in detail later in this chapter).

Moving a sidestick or the rudder pedals creates a command which is sent to the flight control computers. This command, together with information from the Air Data and Inertial Reference System (ADIRS) and other aircraft systems, is processed by the flight control computers. This processed command is then routed to the appropriate flight control surface's electrically-controlled hydraulic actuators. These hydraulic actuators, or servojacks, move the flight control surfaces.

FLIGHT CONTROL COMPUTERS (NORMAL)



In many graphics, one of the flight control computers is shaded, indicating that it is in a standby mode. The specific computer which is operating in the standby mode is determined automatically and is not significant to the pilot.

Flight Control Computers (continued)

Elevator Aileron Computers (ELACs)

Two ELACs are installed. Normally both ELACs are active, providing control of the elevators, ailerons, and the trimmable horizontal stabilizer (THS).

The ELACs compute the need for roll spoiler movement (which is sent to the SECs), and rudder yaw movement (which is sent to the FACs). In the event a single ELAC fails, the other is capable of providing complete control of the ailerons, elevators, and THS.

Spoiler Elevator Computers (SECs)

The three SECs directly control the spoilers. Unlike the ELACs, where the active computer controls both ailerons, each SEC controls only one or two pairs of spoilers. If a specific SEC fails, it's associated spoilers are inoperative.

SEC 1 or 2 provides backup pitch control of the elevators and THS if both ELACs should fail.

Note: SEC 3 does not provide backup control of pitch.

Flight Control Data Concentrators (FCDCs)

The FCDCs acquire flight control data for display on the Electronic Instrument System (EIS) displays and for use by the aircraft maintenance systems (CFDS and AIDS).

Pitch Control

Elevators

Servojacks

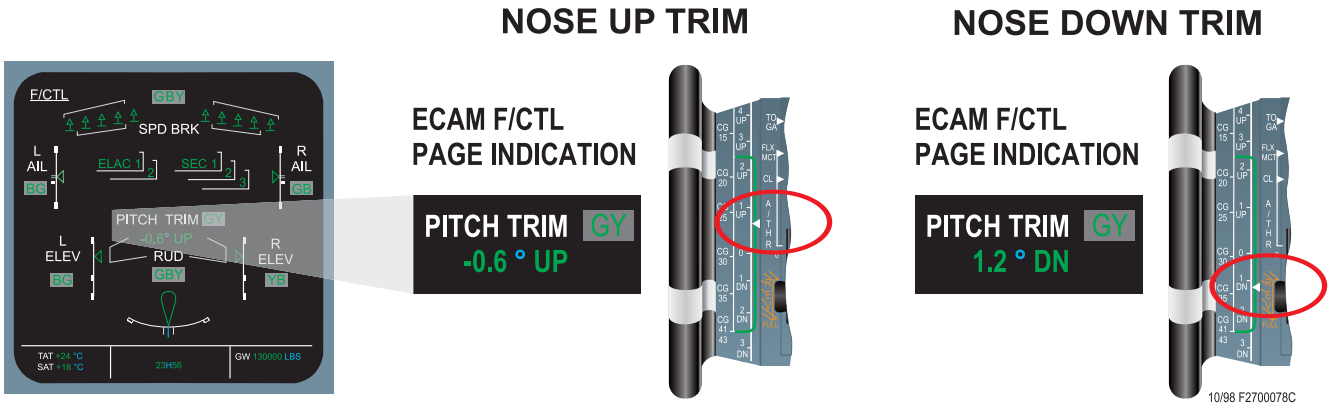
Each elevator is independently moved by one of its two electronically controlled hydraulic servojacks or servos. Only one servo is active at a time, with the other available in case of failure. In the event of a dual failure, the servos revert to a centering mode to hold the elevator streamlined with the horizontal stabilizer. For redundancy, hydraulic power for the elevator servos comes from all three systems (Green, Yellow and Blue). Each elevator is controlled and operated independently. The elevators are not mechanically connected.

Trimmable Horizontal Stabilizer (THS)

The leading edge of the horizontal stabilizer is automatically trimmed up or down to provide pitch trim. It is not necessary for the pilot to manually pitch trim the aircraft. Automatic trimming is available in flight unless multiple failures have occurred or the aircraft has exceeded specified flight envelope limits (discussed later in this chapter).

Pitch Trim System

The THS uses a screwjack to raise or lower the leading edge of the horizontal stabilizer. If the leading edge of the THS is positioned to a negative value, nose up trim results with an UP indication on the trim wheels and F/CTL page.



Hydraulic Power

The THS screwjack is powered by either of two hydraulic motors.The green system powers one motor and the yellow system powers the other. Only one motor operates at a time. Loss of both the green and yellow hydraulic systems results in the loss of stabilizer trim.

Electrical Power

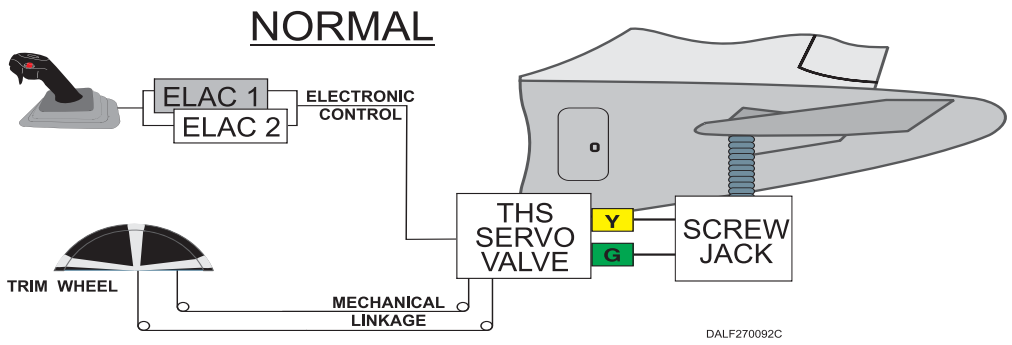
The THS servo valve is normally controlled by one of three electrical motors. In the event of electrical failure, the servo valve can be controlled through mechanical linkage from the cockpit trim wheels. THS control is available as long as either the green or yellow hydraulic system is operable, regardless of electrical power status.

Pitch Control (continued)

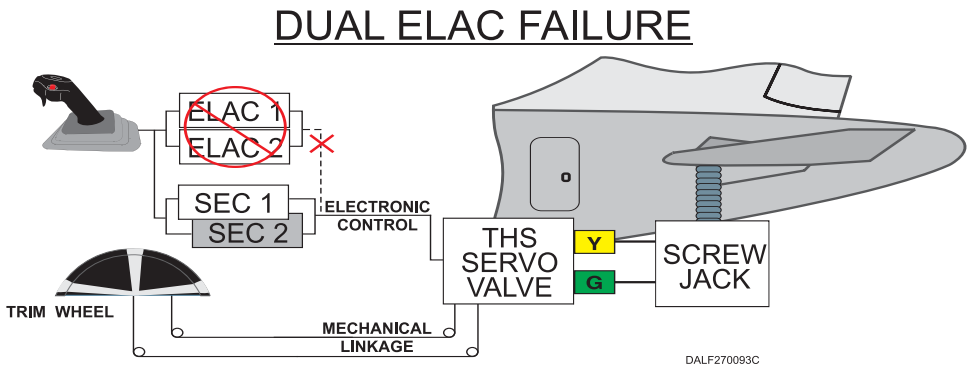
Pitch Trim System (continued)

Computer Control

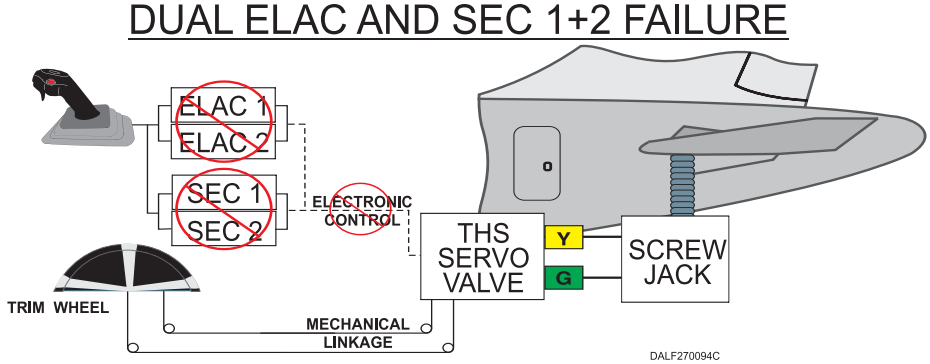
Normal electronic control of the THS is provided by the active ELAC, with the other in standby.



If both ELACs fail, control of the THS is provided by the active SEC, with the other in standby.



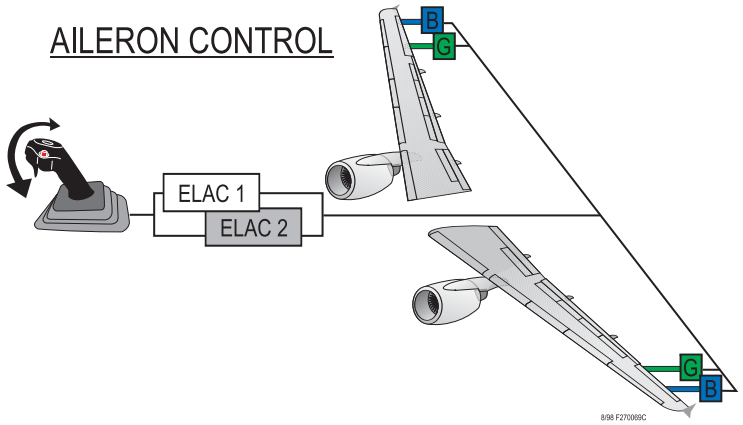
Mechanical control of the stabilizer, if activated, has priority over electronic control. However, its use does not disconnect the controlling computer. In the event of dual ELAC and SEC failures, this mechanical control is available through the trim wheels as long as green or yellow hydraulic power is available.



Roll Control

Ailerons

One aileron is located on the outboard section of each wing. Each aileron can be powered by either of it's two independent hydraulic servos. Each aileron has one servo powered by the green hydraulic system, and one by the blue system. Only one servo on each aileron is active at a time, with the other servo available as a backup. For increased lift, both ailerons droop slightly when the flaps are extended. The ailerons are controlled by the active ELAC.

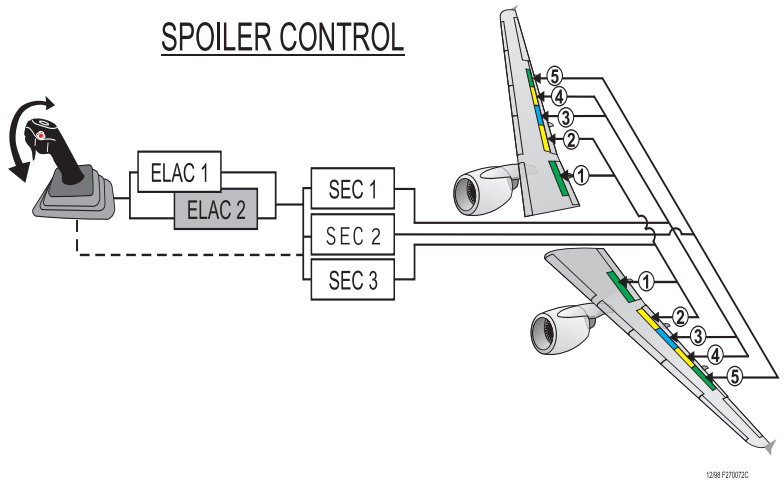


Aileron Failures

If both ELACs fail, both ailerons are inoperative. The aileron servos revert to a damping mode and automatically center. If both the blue and the green hydraulic systems fail, the ailerons are inoperative.

Spoilers

Spoiler panels 2-5 assist the ailerons in providing roll. Unlike the other control surfaces, each spoiler panel is moved by a single hydraulic servo and controlled by a specific SEC. The use of a spoiler panel is lost if either its associated SEC or hydraulic source fails. If one panel fails, the corresponding panel on the opposite wing is deactivated to prevent control asymmetry. Roll commands are normally processed by the active ELAC. If both ELACs fail, the SECs process roll commands and roll is provided only by the spoilers.



Roll Control (continued)

Spoilers (continued)

Spoiler Failures

If a SEC fails or loses electrical power, the associated spoilers will automatically retract.

Aileron Trim

A conventional aileron trim system is not installed, therefore the pilot has no ability to make aileron trim inputs. The ELACs provide automatic lateral trim.

Note: A significant fuel imbalance will result in one aileron being displaced up, and the other down. This is displayed on the ECAM F/CTL page. With the autopilot engaged, a corresponding automatic rudder trim displacement will also occur.

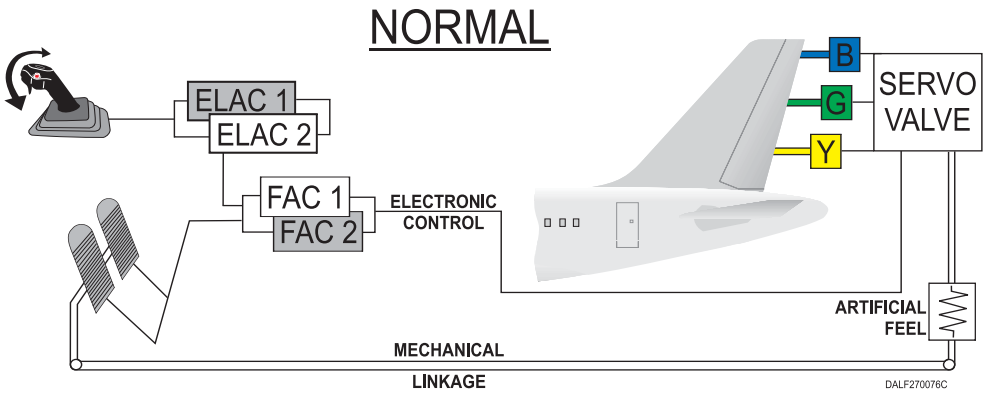
Yaw Control

Rudder

Yaw control is provided by a single rudder that is simultaneously powered by three hydraulic servos. Each servo is powered by a separate hydraulic system to insure that the rudder will be operational as long as any hydraulic system is powered. The rudder pedals are used to make manual inputs. The pedals are mechanically interconnected and are symmetrically displaced with rudder trim inputs. The rudder pedals do not move in response to yaw damping or turn coordination actions.

Rudder Control

Electronic control of the rudder servos is provided by the Flight Augmentation Computers (FACs). Only one FAC is controlling at a time. The other FAC serves as a backup. The active ELAC computes turn coordination and yaw damping commands, which are then sent to the active FAC. The FAC electronically controls the hydraulic servos that move the rudder.



Displacing a rudder pedal with one or both autopilot(s) engaged will cause the autopilot(s) to disengage.

Yaw Control (continued)

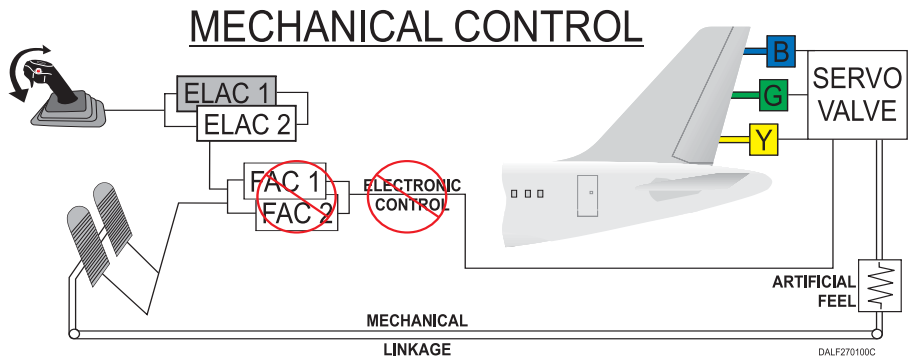
Rudder Control (continued)

The autopilot(s) cannot be engaged if a rudder pedal is significantly displaced from neutral.

Note: Following an engine failure, the autopilot will not engage if the rudder is not trimmed sufficiently prior to engagement.

Manual control of the rudder is available via cables from the pedals to the servos.

Note: At least one functional hydraulic system is required to operate the rudder.



Yaw Dampers

Two yaw dampers are installed. The yaw damper moves the entire rudder as necessary to dampen yaw oscillations. One yaw damper servo is powered by the green hydraulic system, and the other by the yellow hydraulic system. Yaw damper 1 is controlled by FAC 1, and yaw damper 2 by FAC 2. Each yaw damper requires hydraulic power and the corresponding FAC to function. Either yaw damper is capable of providing full yaw damping authority.

Yaw Control (continued)

Rudder Limiting

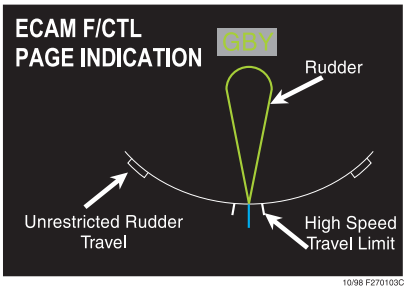
Full rudder deflection at high speeds could produce excessive airframe loads and yaw response. To prevent this from occurring, available rudder travel is gradually restricted as aircraft speed increases. The FACs use Air Data Reference unit (ADR) airspeed data to limit the amount of available rudder travel. Unrestricted rudder travel is available at low speeds.

If both FACs fail, the rudder travel limits are initially frozen.

When the slats are extended, all rudder travel limiting is removed

The ECAM F/CTL page depicts the high speed rudder deflection limits and the maximum amount of rudder travel allowed at low speeds.

The rudder travel limit depiction is fixed and does not move with changes in the rudder travel limit.

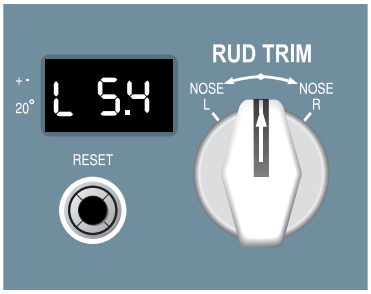


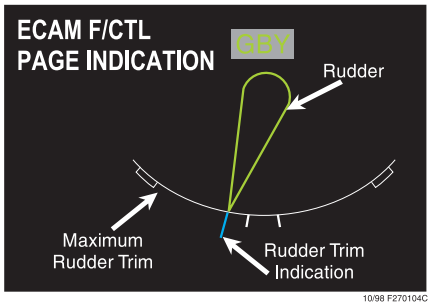
Rudder Trim

Rudder trim is accomplished by displacing the entire rudder surface. There is no rudder trim tab. Rudder trim commands are sent from the FACs to one of two rudder trim motors. As the rudder is trimmed, either manually or by the autopilot, the rudder pedals are symmetrically displaced.

Manual Rudder Trimming

With the autopilots OFF, the rudder may be trimmed by rotating the RUD TRIM knob towards the NOSE L or NOSE R position. Automatic rudder trim does not function with the autopilots off.





Yaw Control (continued)

Rudder Trim (continued)

Automatic Rudder Trimming

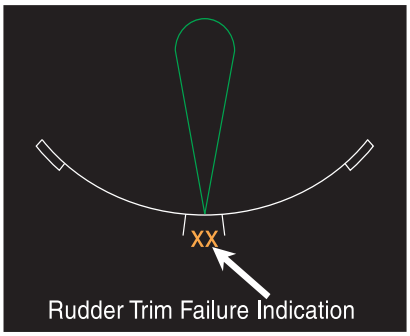
When an autopilot is engaged, rudder trim requirements are computed by the FACs and sent to the rudder servo which displaces the rudder as required (e.g., engine failure). The manual RUD TRIM knob and rudder trim reset pb are inhibited.

Failures

The failure of either FAC or a single hydraulic system does not affect rudder trim. The loss of both FACs results in a total loss of rudder trim capabilities and ECAM F/CTL page rudder trim position indications

The loss of both FACs and rudder trim is indicated by two amber XX's on the ECAM F/CTL page.

This indication also occurs when the rudder trim sensors have failed. In this case, operation of the rudder trim can be confirmed by noting the deflection of the rudder surface and rudder pedals.



Sidesticks

Operation

Pilot commands to the flight control computers are through either sidestick, located outboard of each pilot seat. The sidesticks are spring loaded to the neutral position. There are no mechanical connections from one sidestick to the other or from the sidesticks to the flight control surfaces.

When an autopilot is engaged, solenoids engage to hold the sidesticks in the neutral position. If either stick is moved from neutral with sufficient force to overpower its centering solenoid, the autopilot(s) will disengage. Normally, the autopilots are disengaged by pressing one of the stick-mounted autopilot disconnect/takeover push buttons.

Caution: *Only one pilot should be operating a sidestick at any one time. If both sidesticks are displaced in the same direction, the commands are summed up to a maximum of one stick's full deflection (15° per second). If both sticks are moved to 3/4 deflection right, the summed command roll rate would be the same as one stick at full right deflection, i.e., If the sidesticks are moved equally in opposite directions, the commands will cancel. If the captain commands full nose up stick and the first officer commands full nose down stick, the two stick commands are summed to produce a net command of "no change in pitch."*

Warning

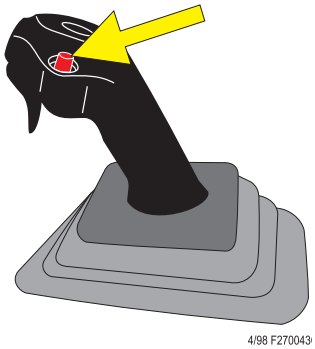
Because there is no mechanical connection between the two sidesticks, simultaneous stick inputs must be avoided.

Sidesticks (continued)

Sidestick Priority

A sidestick priority, or takeover system allows either pilot's sidestick to have sole control of the aircraft in the event of failure of the other sidestick, the autopilot(s), or if the other pilot were to become incapacitated and displace his/her sidestick.

Either pilot can take sole control of the aircraft by pressing and holding the red autopilot disconnect/takeover pb on their sidestick.



Initially, when a takeover pb is depressed, the autopilot(s), if engaged, are disengaged. However, should the pilot continue to depress his/her takeover pb the other sidestick's commands are ignored by the flight control computers. In effect, the other sidestick is deactivated. If the associated takeover pb is depressed for 40 seconds or more, the deactivation logic is latched and the pilot may release the takeover pb without losing sidestick priority.

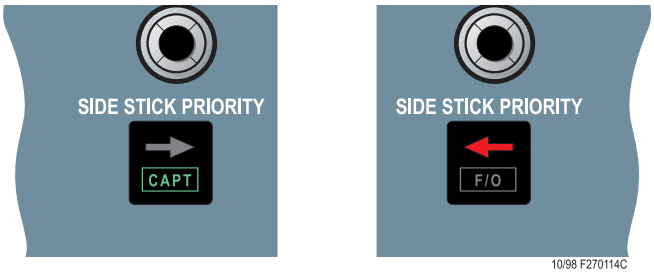
The deactivation logic is only temporary. The other pilot can re-activate his/her sidestick at any time by depressing and holding their takeover pb. The pilot who last depressed their takeover pb has priority.

Side Stick Priority Indicator

A side stick priority indicator, located on each glare shield, can illuminate a red arrow and/or annunciate CAPT or F/O in green respectively.

The red arrow illuminates on the indicator of the pilot whose sidestick has been deactivated and, it points to the pilot who has taken priority. The red arrow remains illuminated as long as the opposite takeover pb is depressed. In addition, a synthesized voice states "Priority Left" or "Priority Right" as appropriate. Should the takeover pb be depressed for more than 40 seconds, the red arrow remains illuminated as a result of the latching of the deactivation logic.

The annunciation CAPTor F/O illuminates on the indicator of the pilot who has taken priority whenever the deactivated sidestick is sensed not to be in the neutral position.



Example: The captain has taken priority, and the FO's sidestick is not sensed in the neutral position.

Note: A deactivated sidestick will trigger the takeoff configuration warning during takeoff or when the ECAM control panel TO CONFIG pb is depressed.

Flight Control Laws

Description

The manufacturer's built-in computer instructions defining flight control movement, flight characteristics, and aircraft limitations are called flight control laws. They limit the computers' authority, establish priorities, adhere to safety parameters, and provide backup capabilities. These instructions cannot be modified by the pilot. For safety and redundancy, there are four major flight control laws provided. The active flight control law automatically changes, in the sequence shown below, only in the event of multiple system failures. The active flight control law will also automatically change to a higher law if failed systems are restored. The flight control laws are:

Normal Law

Normal law is in use when all, or nearly all, aircraft systems are operational. The aircraft's flight envelope is protected, and is automatically limited in pitch and roll, minimum and maximum airspeeds, "G", and angle of attack. No single failure of any aircraft system will result in a loss of normal law.

Alternate Law

Alternate law is automatically in operation following multiple failures in the aircraft's flight control surfaces, hydraulics, electric power supply, or sensor (ADIRU, AOA, pitot-static, etc.) systems. It maintains a high level of fly-through computer capability.

Direct Law

Direct law provides the lowest level of fly-through-computer capability and is automatically in operation when in alternate law and the landing gear is lowered or following more significant failures. In this law, there is a direct relationship between sidestick position and control surface position, and only manual trim is available. This law is similar to the basic flight characteristics of earlier generation aircraft.

Backup Law

This law occurs when all flight control computers have failed or there is a total loss of electrical power. In this law, the sidesticks are inoperative and the aircraft is controlled with the manual pitch trim wheels, rudder pedals, and engine thrust. The purpose of this law is to maintain aircraft control until a higher law can be restored.

Abnormal Law

A flight control law called "abnormal law" is provided when the aircraft attitude is outside the normal law pitch or bank-angle limits. This law can be considered a subset of alternate law.

Abnormal law provides sufficient control for recovery from an unusual attitude.

Normal Law

General

Normal law is the fly-through-computer flight control law active during normal aircraft operations. It directs flight control movements in response to pilot or autopilot commands.

In normal law attitude is stabilized in pitch and roll. With the sidestick in the neutral position, the aircraft will maintain the current pitch and roll attitude.

If the pilot makes a speed or configuration change, the flight control system maintains the desired attitude and automatically make required trim changes.

The functioning of normal law in each aircraft axis is described in detail in the following sections.

Pitch Control

In normal law, pitch control is a load factor demand law, with automatic pitch trimming and flight envelope protections. Fore and aft changes in stick position command changes in the load factor (G load) on the aircraft.

Stick commands are used in the traditional manner to control pitch (e.g., stick aft produces aircraft nose up and stick forward produces aircraft nose down).

- Pulling a stick aft commands an increased pitch load factor. The flight control computers direct the elevators to pitch up, increasing its load factor.
- Allowing the stick to return to neutral commands “one g”. The aircraft maintains its current attitude.
- Pushing a stick forward commands a decrease load factor resulting in a pitch down.

Unlike traditional aircraft, which require very small and deliberate control inputs at high speeds, and very large inputs at slow speeds, a load factor demand produces the same G load change for a given stick position regardless of aircraft speed.

Automatic Pitch Trim

Pitch trim is automatic in normal law, whether flying manually or if an autopilot is engaged. When a sidestick or autopilot commands a change in attitude, the elevators initially move to produce the commanded G (load factor) change. The Trimmable Horizontal Stabilizer (THS) then moves, as required, to maintain the required G, allowing the elevators to streamline behind the THS.

Normal Law (continued)

Roll Control

Left or right sidestick commands are processed by the ELACs, which direct the ailerons and roll spoilers to achieve the commanded roll rate. Maximum bank angle flight limits are provided by normal law.

- Displacing a stick left or right out of neutral commands a change in roll rate. The amount of stick displacement controls the roll rate delivered. Full sidestick deflection produces a roll rate of 15° per second regardless of aircraft speed or configuration.
- Allowing the stick to center (in roll) commands allow zero roll rate, which maintains the current bank angle
- Moving a stick one half travel to the left commands roll left at one half the allowable rate.

Because roll commands are processed by the flight control computers, and the computers have aircraft attitude data available, the flight control computers produce the required pitch control movements to maintain the commanded pitch attitude, even as the roll induced G load on the aircraft changes. Therefore, a pilot does not have to move the stick aft to hold the desired pitch attitude when rolling into a bank, and vice versa when rolling out. This additional roll induced g load is provided up to 33° of bank.

Yaw Control

The yaw orders for turn coordination and yaw damping are processed by the ELACs and transmitted to the FACs. The FACs direct the rudder's hydraulic servos to move the rudder. There is no rudder pedal movement resulting from yaw damping or turn coordination functions. Turn coordination is automatic and no pilot rudder input is required.

When an autopilot is engaged, automatic rudder trimming is also provided.

Normal Law Modes

Description Modes

Normal law is modified depending on the aircraft's phase of flight. There are three normal law modes: flight mode, ground mode, and landing mode.

Flight Mode

The aircraft is in the flight mode of normal law at all times except for during takeoffs and landings. The previous discussion of normal law describes this mode.

Ground Mode

The normal law ground mode is active when the aircraft is on the ground. The ground mode provides a direct relationship between stick and rudder pedal positions and the flight control surfaces. A direct relationship results in control surface displacement being proportional to the stick or rudder pedal displacement.

To insure that the takeoff pitch trim setting does not change, automatic pitch trimming is inhibited.

Takeoff Characteristics

With underwing mounted engines as engine thrust is increased, a significant pitch up moment is created. A forward stick input is recommended to increase the weight on the nose landing gear to improve directional control. This input maximizes the effect of nosewheel steering at lower speeds when the rudder is not effective. The forward stick input is particularly important whenever a tailwind exists, the center of gravity approaches the aft limit, and crosswinds are greater than 20 knots.

For crosswind takeoffs, an aileron input will increase drag (due to deployed ailerons and spoilers) and is not normally required. If necessary, a slight amount of aileron may be used to hold the wings level with strong crosswinds. At or slightly after rotation, aileron inputs should be removed.

Shortly after both main gear are off the ground, the flight controls transition to the flight mode. Roll inputs will result in a roll rate, and pitch becomes load factor demand.

(319 Differences)

Due to the shorter fuselage length, the requirement for a forward stick input during takeoff is more crucial.

Normal Law Modes (continued)

Landing Mode

The normal law landing mode was created to give the flare and touchdown a conventional feel. As the aircraft descends through 50 feet RA, the ELACs memorize the pitch attitude. Beginning at 30 feet RA the ELACs add a gentle nose down command to the memorized pitch attitude. To counter this nose down command requires an aft movement on the stick, in a manner similar to the landing flare of a conventional aircraft.

At main gear touchdown, the ground spoilers (if armed) deploy. Due to the ground spoiler panel's location on the wings, the spoilers kill more lift aft of the CG than forward. This forward redistribution of lift causes the aircraft to pitch up 1-2 degrees as the ground spoilers deploy. This ground spoiler induced pitch change can cause a tail strike to occur *after* touchdown if the aircraft attitude at touchdown is excessive. Refer to the FCTM for the maximum pitch attitude prior to touchdown. The pilot should be prepared to counter this minor pitch up tendency after touchdown, and fly the nose gear to the runway immediately after touchdown. Derotation is conventional and easing off the back stick pressure allows the nose gear to touchdown smoothly.

Note: The use of MED (medium) autobrakes may cause the nose to pitch down more rapidly than desired. The pilot should be prepared to counter this with elevator action.

Shortly after all three landing gear are on the ground, the normal law ground mode becomes active, and the THS is automatically reset to zero. All stick inputs should be removed after the nose gear is on the runway. In the event of a go-around, the transition back to the flight mode occurs above 50 feet RA. At least one functional radar altimeter is required for the landing mode to function. If both radar altimeters are inoperative, the flight controls change to direct law when the landing gear is extended.

Normal Law Flight Protections

Introduction

Normal law provides several airborne protections and stabilities, as follows:

Pitch

- Maneuver protection
- Attitude protection
- High speed protection
- Alpha (angle of attack) protection

Roll

- Bank angle protection

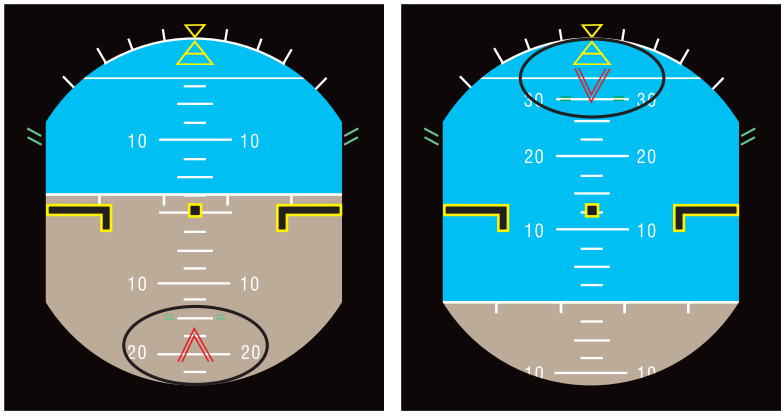
An additional high angle of attack protection feature called Alpha Floor is provided by the autothrust system. Although Alpha Floor functions only when the flight control system is in normal law, it is an autothrust protection, not part of the flight control system. If triggered it commands the engines to TOGA thrust. Refer to chapter 22, Autoflight, for a detailed description of Alpha Floor.

Maneuver Protection

Maneuver protection prevents a pilot from overstressing the aircraft by preventing additional flight control surface movement. It prevents the pilot from exceeding +2.5 or -1.0G when the trailing edge flaps are retracted (this includes position 1 with slats only). In any other flap position (with trailing edge flaps extended) these limits are +2.0G and -0.0G.

Pitch Attitude Protection

Attitude protection limits excessive aircraft nose up and nose down pitch.These attitude limits are displayed on the PFDs as green equal signs at 30° nose up and 15° nose down. The flight control computers further reduce the nose up limits when the flaps are extended and at low airspeeds (the limit marks do not move). If a limit is reached, further stick displacement in that direction produces no effect. At excessively high and low pitch attitudes, the flight directors are removed from the PFDs and red arrows are displayed to indicate the proper direction of attitude movement to return to normal flight.



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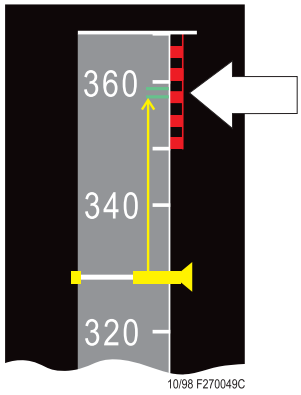
Normal Law Flight Protections (continued)

High Speed Protection

High speed protection prevents aircraft damage due to excess speed. High speed protection activates just above V_{MO}/M_{MO} (red line), and is depicted by a green equal sign. When high speed protection activates, a gentle pitch up is produced by the flight control computers to limit further acceleration. This protection limits maximum airspeed by automatically increasing the aircraft's pitch attitude even if the stick is held full forward. The CRC and MASTER WARN lights activate and an ECAM O/SPEED (overspeed) warning is displayed. The CRC can only be silenced by correcting the overspeed or pressing the ECAM EMER CANC pb. When this protection is active, automatic pitch trim is deactived in the nose down direction. Nose up trim is still available. The autopilot(s), if engaged, will disengage.

The amount of forward stick held and the rate at which the stick was moved forward affects how far the aircraft's speed will increase above V_{MO}/M_{MO} (this permits limited maneuvering if necessary). If the pilot holds the stick full forward, the speed will be stabilized slightly above V_{MO}/M_{MO}. When the pilot returns the stick to neutral, the speed will return to V_{MO}/M_{MO} and high speed protection will be deactivated.



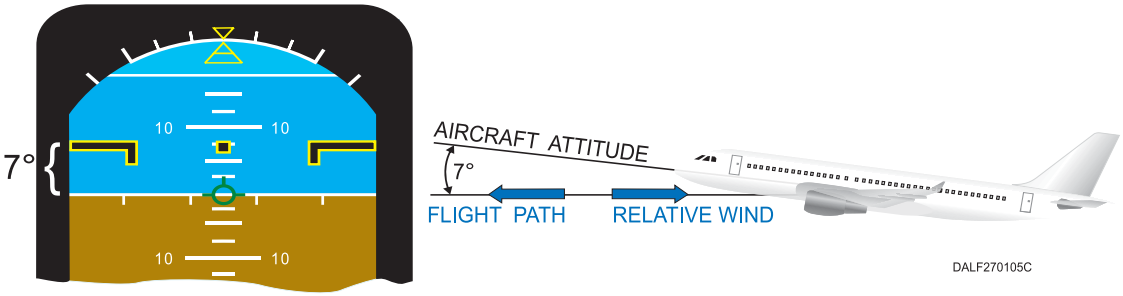
When high speed protection is active, the aircraft bank angle is limited to 45°.

Autothrust Interactions with High Speed Protection

If active, the autothrust system assists the pilot in limiting airspeed below V_{MO}/M_{MO}. If the airspeed is below V_{MO}/M_{MO}, and the pilot inadvertently commands a speed above V_{MO}/M_{MO}, the autothrust system will limit thrust so that $V_{MO}/M_{MO}$is not exceeded. If the airspeed exceeds V_{MO}/M_{MO}, the autothrust system (if active) reduces thrust to idle.

Alpha Protection (Angle of Attack Protection)

Alpha, or angle of attack, is the angular difference between the relative wind and the attitude of the aircraft. The aircraft's current alpha can be easily seen on the PFD as the difference between the Flight Path Angle (FPA) and the yellow "nose of the aircraft" square. In the example below, the aircraft attitude is + 7° and the aircraft's flight path (shown by the FPA symbol) is zero (i.e., level flight).



Normal Law Flight Protections (continued)

Alpha Protection (Angle of Attack Protection) (continued)

The flight control computers monitor alpha and limit control surface position. If alpha was allowed to reach the critical angle, a stall would occur. If pilot action or windshear causes alpha to become excessive, the flight control computers will command the control surfaces to move to prevent alpha from reaching or maintaining the stall alpha. This protection is referred to as Alpha protection.

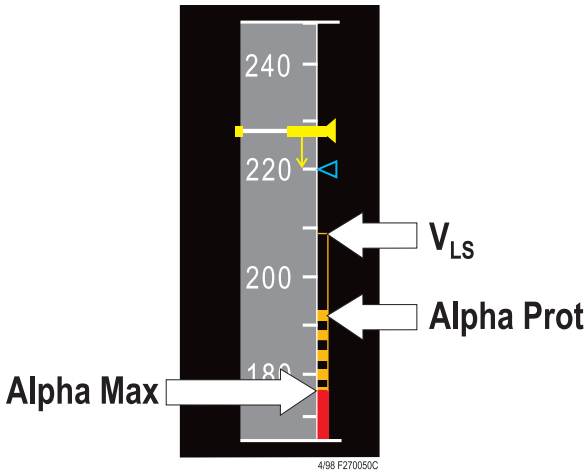
The FACs continuously compute the airspeeds that correspond to the various alpha protection values. These airspeeds are displayed on the PFD airspeed display.

These airspeeds are:

V_{LS}- (lowest safe airspeed) shown by the top of the amber 'hook.'

Alpha Protection (Alpha Prot) - shown as the top of the black and amber band.

Alpha Maximum (Alpha Max) - shown as the top bottom of the red band.



Autothrust and Flight Guidance Interactions with V_{LS}

If active, the autothrust system will not allow the airspeed to decrease below $V_{LS.}$ If the pilot inadvertently selects an airspeed below V_{LS}, the autothrust system will increase thrust to maintain a minimum of $V_{LS.}$

In addition, if a flight director is on or an autopilot is engaged, regardless of the status of the autothrust system, the flight guidance system will not display a pitch command that would result in an airspeed below $V_{LS.}$

Alpha Prot

At alpha prot, the pitch command logic shifts from load factor demand to a protection mode where sidestick position commands angle of attack directly to prevent stalling the aircraft.

At alpha prot, the autopilot (if engaged), will disengage, and the speed brakes (if extended) automatically retract. Additional nose up trim is inhibited. Nose down trim is still available.

Normal Law Flight Protections (continued)

Alpha Protection (Angle of Attack Protection) (continued)

ALPHA MAX

For the aircraft to slow below Alpha Prot, the pilot is required to pull the stick further aft. If the stick is released, the airspeed returns to Alpha Prot.

ALPHA FLOOR

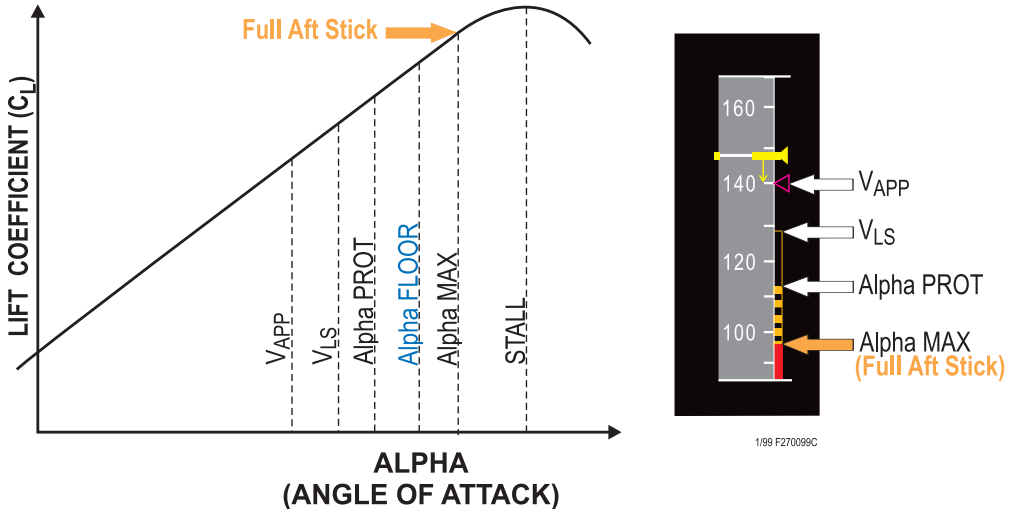
If the autothrust system is *available*, whether currently active or not, the autothrust system will activate and command the engines to TOGA thrust as Alpha Floor is reached. Alpha Floor activation occurs approximately half way between Alpha Prot and Alpha Max. Alpha Floor is not depicted on the airspeed display.

If the pilot continues to hold full back stick, the aircraft will climb out at Alpha Max and TOGA thrust until full aft stick is released.

Note: Remember that the Alpha Floor protection is a function of the autothrust system, not the flight control system.

Alpha Max is the highest alpha that the ELACs will allow for the current aircraft weight and configuration. An audible stall warning will not sound and the aircraft will not stall. If the pilot allows the sidestick to return to the neutral position, airspeed will return to Alpha Prot. Stick movement forward of neutral is required to recover from Alpha Prot and regain full automatic pitch trim and the use of the autopilot(s).

Alpha protection provides the pilot with a simple means of achieving maximum performance. Maximum allowable lift for a given configuration is generated at Alpha Max, which is slightly below the stall alpha. The speed brakes automatically retract at Alpha Prot, and TOGA thrust is automatically commanded by Alpha Floor (additional actions are required by Vol. 1/QRH during windshear and EGPWS recoveries.



Note: In normal law the pilot cannot command an angle of attack that will cause a stall.

Normal Law Flight Protections (continued)

Bank Angle Protection

Maximum bank angle in normal law is limited to 67° as indicated by green equal signs on the PFD. Even if a pilot holds full stick deflection in roll, the bank angle is limited to 67°. If the bank angle exceeds 45°, the autopilot(s) will disconnect and the flight director displays will be removed from the PFDs. The bank angle limits are further reduced if other protections are active.

Example: If alpha protection or high speed protection is active, maximum bank angle is limited to 45°, automatic pitch trim is inoperative, and positive spiral stability (discussed later) begins at 0° of bank.

Normal Law Characteristics

Autopilot Operation

When an autopilot is engaged in normal law, protections remain effective. The Flight Management and Guidance Computers (FMGCs) send pitch and roll orders to the ELACs. The THS is automatically trimmed to streamline with the elevator to reduce drag. The FAC automatically trims the rudder. Manual rudder trim is unavailable.Significant pilot rudder or sidestick inputs will cause the autopilot(s) to disengage.

Engine Failures

If an engine fails with an autopilot engaged, the flight control system automatically compensates for the asymmetric thrust by trimming the rudder. If sufficient thrust is available, no immediate pilot action is required to maintain the desired attitude.

If an engine fails without an autopilot engaged and the pilot does not take any action, the flight control system automatically maintains the existing pitch and roll attitude. The rudder is **not** automatically trimmed.

Roll and yaw due to the asymmetric thrust is compensated for by the deflection of ailerons and spoilers. After an engine failure during takeoff or initial climb, the resulting drag from these surfaces can significantly reduce the climb rate. The pilot should eliminate the yaw by referring to the PFD slip indicator and using manual rudder, then rudder trim. An autopilot can then be engaged, if desired.

Note: The autopilot may not engage, or remain engaged, if the pilot fails to apply sufficient rudder trim prior to engagement.

Positive Spiral Stability

Positive spiral stability is defined as the tendency of an aircraft to roll out of a bank angle when the stick is released. Normal law has neutral spiral stability at bank angles up to 33°, and positive spiral stability at greater bank angles. If the stick is released at a bank angles from 0° to 33°, a zero roll rate is commanded and the bank angle does not change. If the bank angle exceeds 33°, positive spiral stability becomes active. The pilot can increase bank up to a maximum of 67°. However, once past 33°, a stick roll deflection must be held to prevent the aircraft from returning to 33° of bank automatically. In addition, the pilot must now hold back pressure to maintain a constant altitude turn, because auto trim is inhibited.

Example: In normal law during a 45° bank turn and the stick is released, the bank angle will automatically decrease to and then maintain 33° of bank.

Whenever alpha or high speed protection is active, positive spiral stability is active at any bank angle. This will cause the aircraft to reduce to and then maintain 0° of bank whenever the stick is returned to neutral in roll.

Normal Law Characteristics (continued)

Flight In Turbulence

With the autopilots off and the sidesticks neutral, the aircraft maintains its current pitch attitude and zero roll rate. If the aircraft encounters light turbulence, it will maintain the last pitch and roll attitude commanded by the pilot. Significant turbulence results in uncommanded pitch and roll movements. An uncommanded pitch movement due to turbulence is removed by the flight control computers and the aircraft is returned to its previous pitch attitude. An uncommanded roll movement is stopped by the flight control computers and the aircraft remains at the new bank angle. This requires a pilot input to return the aircraft to the desired flight path. Because the flight control computers automatically stop any uncommanded roll rates due to turbulence, the pilot is only required to make inputs that correct the flight path back to the desired course.

Pilot Induced Roll Oscillations

When flying in turbulent air which results in bank angle changes, the natural time delay, or lag, in the aircraft's response can appear to be a lack of response to the turbulence. If the pilot attempts to assist the flight control system in correcting for the turbulence, the pilot input is added to the flight control's response, and a bank angle error in the opposite direction occurs. This appears to be additional turbulence to the pilot, who then makes a bigger input in the opposite direction, aggravating the problem.

This is most likely to occur during final approach, as the natural tendency is to accept smaller errors in the aircraft's flight path as the aircraft approaches the runway. In general, if the pilot is making rapid side to side inputs in turbulence, the pilot is causing most of the roll oscillations. If the pilot inputs are removed by holding the sidestick neutral for a few seconds, the aircraft will stabilize at the current bank angle. The pilot should concentrate on making inputs which correct the aircraft's flight path, and not get involved with "fighting" the turbulence.

Changes In The Active Flight Control Law

General Rule

A single failure of any computer type, Air Data and Inertial Reference Unit (ADIRU), hydraulic system, or other system will not change normal law to another law. At least a dual failure in a specific system is required to cause a change.

The active flight control law will also automatically change to a higher law if failed systems are restored.

Summary

There is no requirement for pilots to memorize the specific failure conditions that will result in changes in the active flight control law. The PFD and ECAM displays make it readily apparent to the crew what flight control law is currently in use, as well as any specific pilot actions required to operate in that law.

It is important for pilots to understand the indications on the PFD and the ECAM and what protections are available in order to properly react to malfunctions. Due to the multitude of different combinations of malfunctions that are possible, memorizing charts of malfunctions is not recommended.

Alternate Law

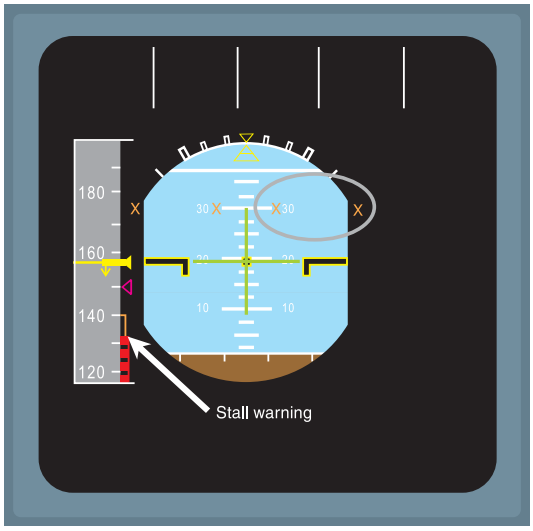
Description

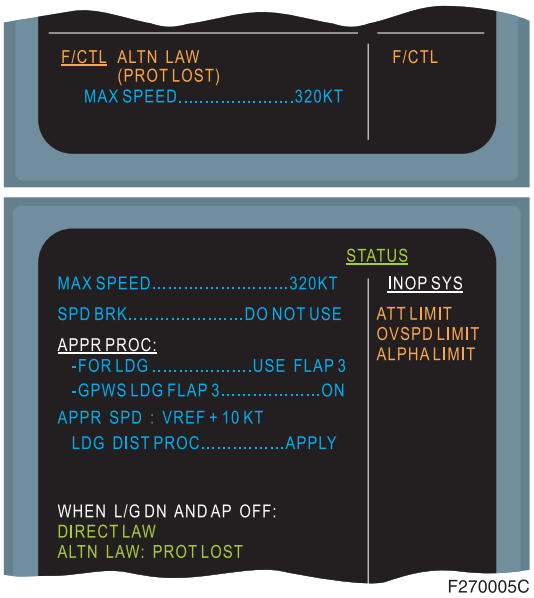
Alternate law becomes active in the event of multiple failures of the flight control computers, ADIRS, hydraulic systems or other aircraft components affecting the flight controls.

Note: In general, the pilot will not notice significant changes in the aircraft's flying qualities. The primary difference is a loss or reduction in flight envelope protections. Depending on the specific failure, the autopilot(s) may operate.

When normal law is not active, the PFDs display amber "X"s where the normal law green equal signs were formerly located. On the airspeed indicator, Alpha Prot and Alpha Max are replaced by a stall warning indication.

When alternate law is active, an ECAM "F/CTL ALTN LAW: (PROT LOST)", memo is displayed in amber. The ECAM will display the appropriate checklists to attempt restoration of normal law, the systems affected, and current status of the aircraft.





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Alternate Law (continued)

Pitch Control

Pitch control is similar to normal law. Using load factor demand law with automatic pitch trimming.

Roll Control

In alternate law, there is a direct relationship between stick position and the roll control surfaces' deflection or extension. As a result roll, response now varies with aircraft speed.

Positive spiral stability is not available.

Yaw Control

In alternate law, automatic turn coordination is lost. Pilot rudder application is required for turn coordination.

In most cases of alternate law, yaw damping remains functional but has limited authority. All other rudder functions are normal (assuming at least one functional FAC).

Landing When Alternate Law is Active

When the landing gear is extended, direct law becomes active. In the event of a go-around, the flight controls transition back to alternate law when the gear is retracted. Direct law is discussed later in this chapter.

Alternate Law Protections and Stabilities

General

The table below compares the protections in Normal Law to Alternate Law. Maneuver protection is the only protection that remains unchanged.

Normal Law Protection	Alternate Law Protection
Maneuver protection	No change
Attitude protection	Not available
High Speed protection	Replaced by high speed stability
Alpha (angle of attack) protection	Replaced by low speed stability
Bank angle protection	Not available

Note: The autothrust Alpha Floor protection is not available in alternate law.

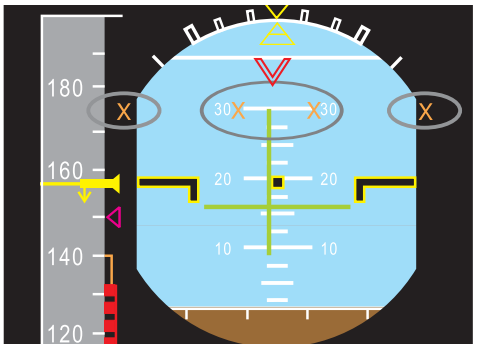
Alternate Law Protections and Stabilities (continued)

Attitude and Bank Angle Protections are Lost

In alternate law, attitude protection is lost. The normal law green attitude limit marks are replaced by amber Xs

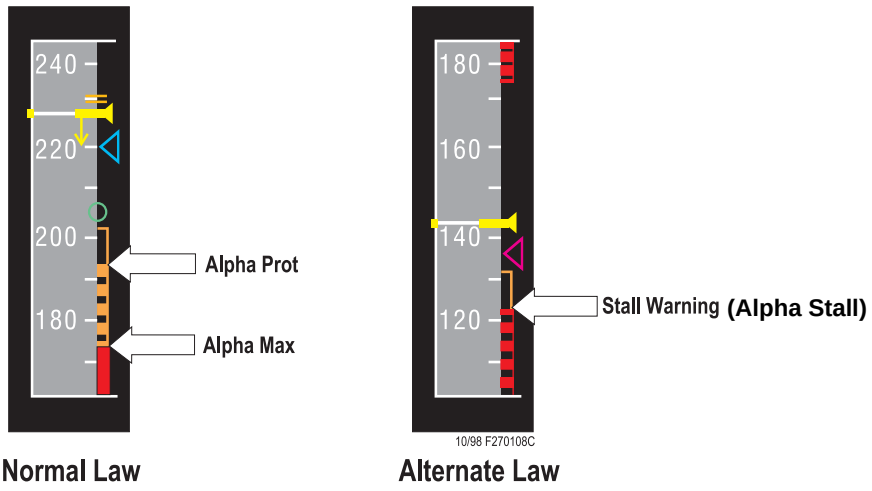
When alternate law is active there are no limits for either pitch or roll.

Note: Bank angle hold and positive spiral stability do not function in alternate law.



Alpha Prot Is Lost

In alternate law, Alpha Prot and Alpha Max are no longer displayed. As shown below, aircraft stall speed (Alpa Stall) is now displayed on the PFDs as the top of a red and black barber pole. A synthesized voice will state STALL...STALL at the stall warning speed.



Note: If alternate law was the result of a dual FAC failure, all characteristic speeds (e.g., stall speed, V_{LS}, etc.) on the airspeed displays are lost.

Alternate Law Protections and Stabilities (continued)

Stabilities

In alternate law, high speed and angle of attack protection are lost, and replaced with stabilities. A protection *prevents* the pilot from exceeding a limit, while a stability only *discourages* exceeding a limit. Stabilities are flight control commands that smoothly attempt to change pitch to prevent an overspeed or low speed/high alpha(stall) condition. Pilots can manually override either stability with stick movement, causing an overspeed or a stall to occur. There are two stabilities in alternate law: high speed and low speed.

If the flight control computers are prevented from receiving reliable airspeed data, these stabilities are not available (discussed later in this section).

High Speed Stability

High speed stability replaces overspeed protection. At a speed slightly below V_{MO}/M_{MO}, high speed stability automatically commands elevator movement to increase the aircraft's pitch, preventing additional speed increase. If a pilot applies additional forward stick, high speed stability can be overridden, and the aircraft's speed will increase and structural damage can occur. If the aircraft exceeds V_{MO}/M_{MO}, the master warning lights flash and a CRC (Continuous Repetitive Chime) sounds.

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Low Speed Stability

Low speed stability replaces alpha protection. Low speed stability activates when the airspeed decreases to a few knots above stall warning. Low speed stability automatically commands elevator movement to decrease the aircraft's pitch attitude. If low speed stability is active and additional aft stick is applied, low speed stability can be overridden and the aircraft can be stalled.

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Alternate Law Protections and Stabilities (continued)

Alternate Law Without Stabilities

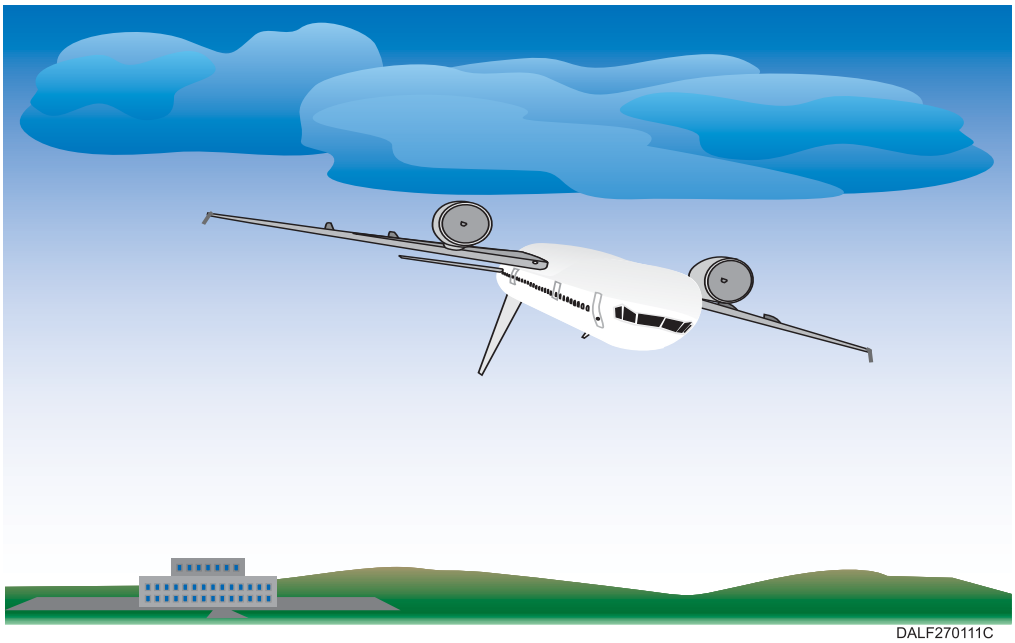
When malfunctions prevent the flight control computers from receiving reliable airspeed information, alternate law without stabilities is active. The ECAM E/WD message F/CTL ADR DISAGREE is one example of this situation. A triple ADR failure would also cause alternate law without stabilities.

If alternate law without stabilities was caused by an ADR disagreement, placing the malfunctioning ADR pb to OFF (in accordance with the ECAM and QRH procedures) will allow high and low speed stabilities to be regained.

Abnormal Attitude Law

Description

If the protection limits of normal law are exceeded due to outside forces (e.g. severe turbulence, a mid-air, etc.) abnormal attitude law becomes active. Abnormal attitude law ensures that the computerized flight control laws do not prevent or interfere with recovery from an abnormal flight condition. Recoveries can be made from such attitudes as inverted flight, vertical climbs or dives.



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While normal law attitude limits are being exceeded, the abnormal attitude law is Alternate Law Without Stabilities, without automatic pitch trim or yaw damping.

After the recovery is complete and the aircraft is back within the normal law attitude limits, automatic pitch trimming and yaw damping are restored, however, the aircraft will remain in alternate attitude law until after landing. The flight control law will not upgrade to normal law.

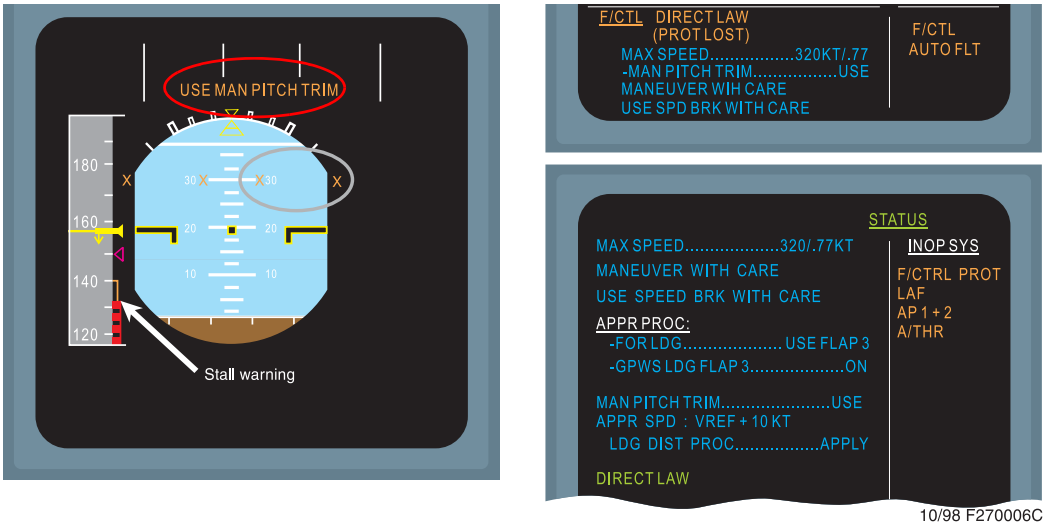
The flight control laws will remain in alternate law after the landing gear is extended.

Direct Law

Description

In direct law, pilot commands are sent, unmodified by the flight control computers, directly to the flight control surfaces. Direct law has no modes (i.e., there are no landing or ground modes as in normal law).

When direct law is active, an amber USE MANUAL PITCH TRIM message is displayed on the FMA. Also, the message F/CTL DIRECT LAW is displayed on the ECAM E/WD and status page, and the Master Caution sounds.



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Multiple failures are required to cause a change from normal law to direct law. Direct law is most likely to occur as a result of landing gear extension when in alternate law.

Direct Law Pitch, Roll and Yaw Control

Direct law is a direct relationship between stick and rudder pedal deflection and flight control surface movement. Aircraft response to flight control inputs will change depending on the speed and configuration of the aircraft.

Rudder trim and rudder limiting will be available unless the failure causing direct law occurred in the rudder control system. Mechanical control of the rudder is always available through the rudder pedals anytime there is green, yellow, or blue hydraulic system pressure available.

Automatic pitch trim is not available in direct law. The pilot must manually trim the aircraft using the mechanical pitch trim wheels. Manual trim is available as long as there is hydraulic pressure available to either the green or yellow hydraulic systems. The speed brakes should be used with caution, allowing time to make manual pitch trim corrections.

Direct Law (continued)

Direct Law Pitch, Roll and Yaw Control
(continued)

Caution: *A failure to use sufficient manual trim during approach and landing in direct law may result in insufficient aft stick travel being available to satisfactorily complete the flare.*

Example: The aircraft is flying an approach in alternate law. When the landing gear is lowered at 180 KIAS, the flight controls transition to direct law, and automatic pitch trim is unavailable. If the pilot fails to use manual pitch trim while slowing to a V_{APP} of 140 KIAS, a significant amount of the available up elevator travel will have been used to counter the out of trim stabilizer position. This may result in insufficient up elevator authority for the flare.

Direct Law Flight Warnings

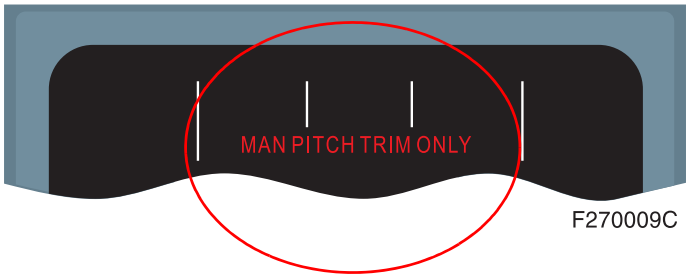
There are no protections or stabilities in direct law. Stall and overspeed warnings will sound at the appropriate airspeeds. The aircraft can be stalled or oversped in direct law.

Backup Control (Mechanical Control)

Description

For redundancy, backup flight control through mechanical means is available even after a complete loss of flight control computers or electrical power. The aircraft can be flown indefinitely using backup control. However, backup control is intended to be used only for as long as it takes to restore computer flight control. Hydraulic pressure must be available for backup control to function.

When backup control is active, a red MAN PITCH TRIM ONLY message is displayed on the FMA and the sidesticks are inoperative.



Backup Pitch Control

Pitch is controlled using the pitch trim wheels through a mechanical connection to the THS hydraulic servos. There is significant lag between a trim input and the aircraft response. Deliberate and slow changes in speed and configuration work best in backup control.

Backup Yaw and Roll Control

Yaw and roll are controlled using the rudder pedals via cables to the rudder's hydraulic actuators. In backup control, neither ailerons nor roll spoilers are available. The design stability of the aircraft, combined with control of yaw through the rudder, controls roll (e.g., gentle left rudder application produces a nose left yaw which produces a roll to the left). As with any conventional aircraft, when the G load increases due to bank, the pilot must add nose up pitch to maintain altitude.

Note: Due to the under wing mounting of the engines, pitch is significantly affected by engine thrust changes; adding thrust will produce a large nose up response and reducing thrust will produce nose down. Asymmetric, or differential, engine thrust changes result in significant yaw/roll rates. Therefore, thrust changes should be made in small increments, allowing time for appropriate pitch trim wheel inputs.

When the red "MAN PITCH TRIM ONLY" message is displayed the sidesticks are inoperative.

Note: There is one exception to this condition. If only SEC 3 is functional, a limited amount of roll control is available with the sidesticks. However, SEC 3 does not provide any backup pitch control.

Slats and Flaps

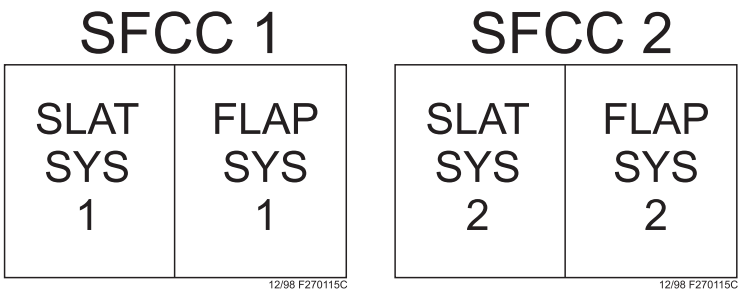
Description

The A319/320 uses five leading edge slats per wing and two pair of trailing edge flaps for enhanced low speed lift. All of the slats and flaps are operated as groups via torque tubes. The slat torque tubes are rotated by a dedicated slat Power Control Unit (PCU), and the flap torque tubes have their own Flap PCU. Each PCU is powered by two motors powered by different hydraulic systems. Dual Slat Flap Control Computers (SFCCs), two PCUs, and dual PCU hydraulic motors, prevent any single failure from disabling either the slats or flaps. If one hydraulic motor in a PCU fails, the PCU and its associated slats or flaps will operate at half speed. If both hydraulic motors in a PCU fail, that PCU will not operate, resulting in a failure of either the slats or flaps. The other PCU operates independently.

Example: If the blue hydraulic system fails, the slats will operate slowly. The flaps will operate at normal speed.

Slat Flap Control Computers

The flap handle sends commands to each of the two SFCCs. Each SFCC controls one hydraulic motor in the Flap PCU and one hydraulic motor in the Slat PCU. This design allows for the failure of either SFCC without the loss of flaps or slats. Each SFCC has a slat channel and a flap channel.



The SFCCs monitor the position of the slats and flaps. If an asymmetry, uncommanded movement, or runaway is detected, the SFCC sends a signal to Wingtip Brakes (WTBs) that lock the appropriate torque tube to prevent further movement. Once applied the wingtip brakes can only be released on the ground.

The slat and flap wingtip brakes operate independently. If the slat wingtip brakes are on, the flaps will operate normally. If the flap wingtip brakes are on, the slats will operate normally.

SFCC Failures

If one SFCC slat or flap channel fails, the other SFCC will take control of that function. An ECAM SLAT SYS 1 (2) or FLAP SYS 1 (2) message is displayed.

If both SFCC slat or flap channels fail, the slats or flaps will be inoperative. An ECAM SLATS FAULT or FLAPS FAULT message is displayed, and slats or flaps are inoperative in this condition.

Note: The ECAM displays the status and results of single or multiple failures in the slat or flap systems.

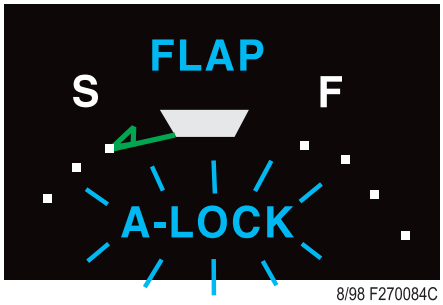
Slats and Flaps (continued)

Slat Alpha/Speed Lock

If alpha (angle of attack) is excessive or the airspeed too low, the slat alpha speed lock protection prevents the slats from retracting to UP, even though the pilot has selected the flap handle UP.

A-LOCK is displayed on the E/WD while slat retraction is inhibited.

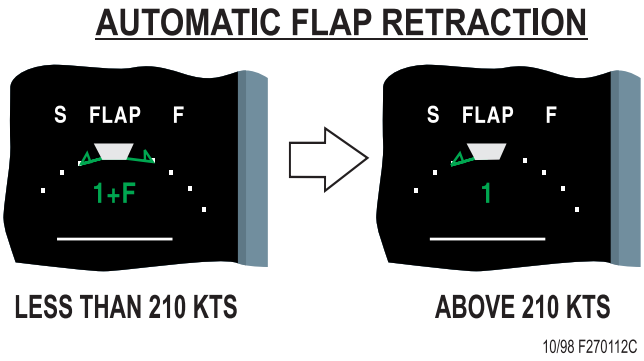
Once alpha and airspeed are normal, the inhibition is removed and the slats will then retract normally.



8/98 F270084C

Automatic Flap Retraction

If the flaps are at 1+F and the aircraft accelerates to 210 kts or above, the trailing edge flaps will automatically retract. The leading edge slats remain extended.



10/98 F270112C

Speed Brakes and Ground Spoilers

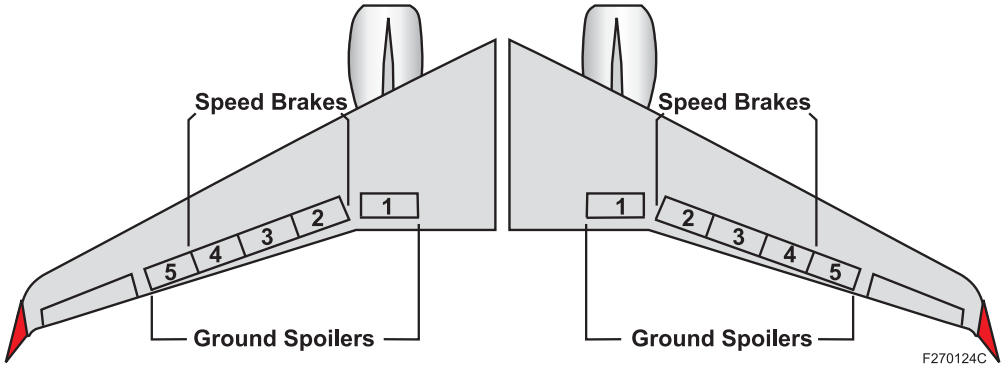
Description

Each wing is equipped with 5 hydraulically powered spoiler panels which assist in roll control and serve as speed brakes and ground spoilers. Numbered 1 through 5, speed brake and ground spoiler operation is controlled and monitored by the aircraft's Spoiler and Elevator Computers (SECs).

In addition, there is a dedicated SPEED BRAKE control lever located on the center pedestal.

In the event of spoiler panels failure, the corresponding number panels on the other wing will be automatically inhibited.

Ground spoiler operation differs from speed brake operation in that, ground spoilers utilize all 5 spoiler panels on each wing, whereas speed brakes only utilize panels 2,3 and 4 on each wing.



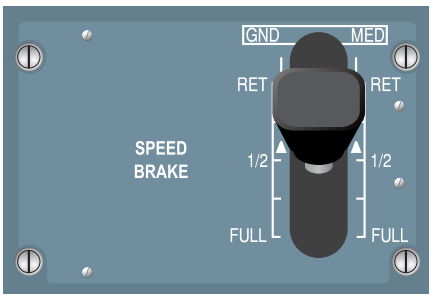
Speed Brake Deployment

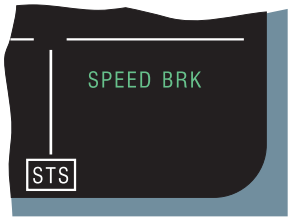
Speed brakes can only be deployed when in flight, by manually moving the SPEED BRAKE lever backwards from the RET position. Conversely, moving the lever forward retracts the speed brakes. Speed brakes may be deployed with any Flap/Slat position with the exception of Flaps Full.

Note: The speed brake lever is incapable of automated movement and must always be manually positioned.

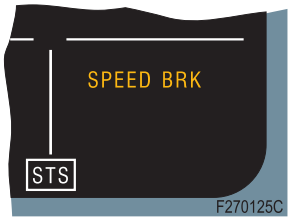
When deployed, regardless the amount of deflection, an ECAM message SPEED BRK (green) appears on the E/WD memo section. The message turns amber if the speed brakes are deployed and engine thrust is above idle speed.

SPEED BRAKE LEVER





SPEED BRAKES DEPLOYED
ENGINE THRUST AT IDLE



SPEED BRAKES DEPLOYED
ENGINE THRUST ABOVE IDLE

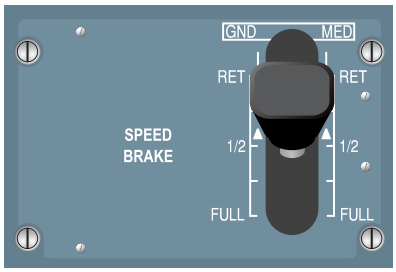
Speed Brakes and Ground Spoilers (continued)

Speed Brake Auto Retraction

When deployed, the speed brakes will automatically retract under the following conditions.

- Flaps FULL is selected
- Airspeed decreases to Alpha Prot (Normal Law)
- TOGA thrust is selected

In the event that the speed brakes have been automatically retracted, the message F/CTL SPD BRK DISAGREE appears on the E/WD memo section.



F270127C

Note: Once the condition that caused the automatic retraction has been corrected, and the speed brake lever has been moved to the RET position, it may take up to 10 seconds before the speed brakes can once again be deployed.

Speed Brake/ Autopilot Interaction (A320 only)

On the A320, when an autopilot is engaged, the amount of speed brake deployment is limited to 1/2 their maximum capability. Placing the speed brake lever beyond the 1/2 position will yield no further deployment. However, if the speed brake lever were placed beyond the 1/2 position and the autopilot were to disengage, the speed brakes would immediately position themselves to the corresponding lever position.

With the autopilots off, if the speed brakes are deployed beyond their 1/2 position, and subsequently an autopilot is engaged, the speed brakes will immediately retract to the 1/2 position.

Note: Engaging or disengaging an autopilot with the speed brakes deployed beyond 1/2 is not recommended due to the abrupt automatic retraction or extension of the speed brakes.

Speed Brake/ Autopilot Interaction (A319 only)

On the A319, autopilot engagement does not limit the amount of speed brake deployment. The speed brakes will respond to all lever positions.

Note: On the A319, the maximum deflection (FULL) of the speed brakes is equal to the 1/2 deflection on the A320.

Speed Brakes and Ground Spoilers (continued)

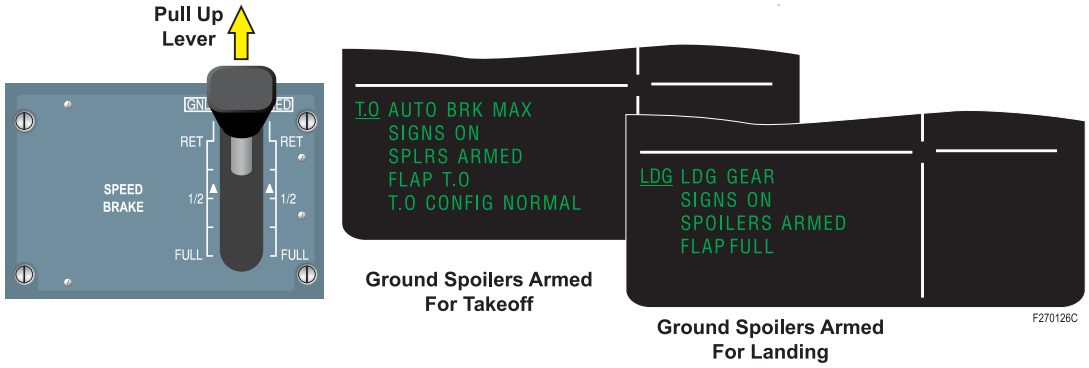
Ground Spoiler Deployment

The ground spoilers deploy automatically for an aborted take off or upon landing. Based on whether the ground spoilers were armed or not, deployment will occur when idle thrust is selected or when reverse thrust is selected.

Ground Spoilers Armed:

The ground spoilers are armed for deployment by pulling the speed brake lever up when in the RET position. When armed, the ECAM memo message SPLRS ARMED appears on the ECAM TAKE OFF or LANDING memo section.

Note: The speed brake lever can only be pulled up for arming the ground spoilers when in the RET position.



Ground Spoilers Armed For Takeoff

Ground Spoilers Armed For Landing

Once armed, deployment automatically occurs for both an aborted take off or upon landing when the following conditions are met:

- main gear wheel speed of 72 kts or greater
- both thrust levers retarded to the idle thrust position

Caution: *If takeoff is aborted prior to wheel speed reaching 72 knots, a ground spoiler deployment signal will not be generated. This lack of deployment signal will also prevent autobrake operation.*

Note: To reset the ground spoiler and wheel autobrake logic following an aborted takeoff, the ground spoilers must be disarmed and then rearmed for subsequent takeoff.

Ground Spoilers *NOT* Armed:

If the ground spoilers are *not* armed, deployment automatically occurs for both an aborted take off or upon landing when the following conditions are met:

- main gear wheel speed of 72 kts or greater
- at least one thrust lever in the reverse thrust range and the other at thrust idle

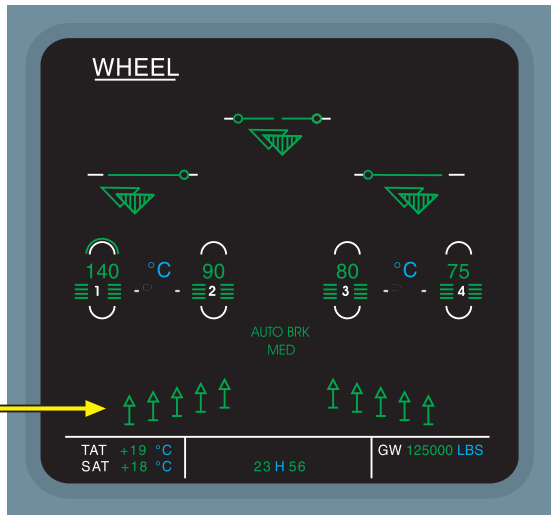
Note: If runway conditions prevent wheel speed from reaching 72 knots upon landing, automatic deployment of the ground spoilers will occur as described above if inputs from the Radio Altimeters and both main landing gear confirm that the aircraft is on the ground.

Note: After an aircraft bounce, the ground spoilers remain deployed if the thrust levers remain in idle.

Speed Brakes and Ground Spoilers (continued)

Deployment Indications

When the ground spoilers have deployed, their deployment can be confirmed by the appearance of green vertical arrows on the ECAM F/CTL page.



Ground Spoilers Fully Deployed

Partial Ground Spoiler Extension

To reduce the possibility of hydroplaning, the ground spoilers will partially extend (10 degrees) when only one landing gear strut has compressed, and at least one thrust lever is in the reverse thrust range. This feature is designed to help the aircraft settle after crosswind landings or landings on wet or contaminated runways.

Note: If only one engine reverser is operable, it should be selected to at least idle reverse to allow partial extension feature to function.

Once both struts have compressed, the ground spoilers will fully deploy.

Manual Ground Spoiler Extension

The ground spoilers can be manually deployed by placing the speed brake lever to the FULL position once the aircraft is on the ground.

Caution: *Manual deployment of the ground spoilers using the speed brake lever limits the number of spoiler panels that will deploy (1 thru 4). Furthermore, when FLAPS FULL is selected, spoiler panels 2, 3 and 4 are automatically inhibited; therefore, only one spoiler panel per wing, number 1, will deploy.*

Ground Spoiler Automatic Retraction

If the ground spoilers were armed for deployment, they will automatically retract when the speed brake lever is disarmed. If they had deployed with out being armed, retraction occurs when idle thrust or higher is selected.

Flight Augmentation Computers (FACs)

General

The two identical FACs perform the following functions:

- yaw damping and turn coordination (refer to chapter 27, Flight Controls),
- rudder trim and rudder limiting (refer to chapter 27, Flight Controls),
- flight envelope and maneuvering speed computations,
- alpha floor protections,
- windshear detection, and
- low energy warning computations.

Note: Some FAC functions are inoperative if the flight controls are not in normal law.

FAC Power and Resets

The FACs are automatically powered when aircraft electrical power is established. The FACs may be reset with the FAC pbs on the overhead panel. Selecting a FAC pb to OFF deactivates the corresponding yaw damper and rudder trim functions corresponding to that FAC. However, with the pb off, the FAC (if operable) continues to compute all flight envelope functions and provide PFD flight envelope and maneuvering speed indications.

Gross Weight Calculations

When airborne, the FACs independently determine the aircraft gross weight using aircraft angle of attack sensors. These calculations are independent of the FMS gross weight calculations. If a significant difference occurs between the FAC and FMS gross weights, the following message is displayed:

10/97 F220039C

If the FMS gross weight is in error, it may be corrected on the MCDU FUEL PRED page. The FAC gross weight cannot be modified by the pilot.

Caution: *If the FMS gross weight is incorrect, managed speeds should not be used, especially during approach and landing.*

Flight Augmentation Computers (FACs) (continued)

Flight Envelope

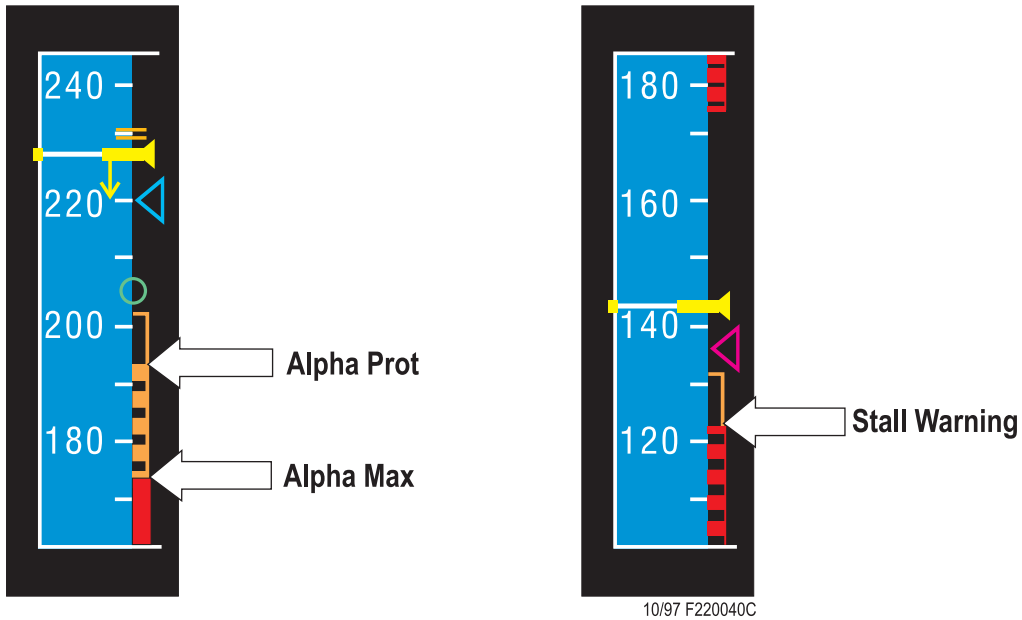
The FACs compute many different types of speeds for use by the autoflight system. Many of these computed speeds are displayed on the PFD airspeed indicator.

These speeds include the minimum safe speed, the maximum speed for the current configuration, and a never exceed speed. These speeds are displayed on the PFD airspeed indicator and are called characteristic speeds. They are discussed in detail later in this chapter (refer to Speed Guidance).

The FACs also compute the following characteristic speeds for display on the PFD airspeed indicator and for use by the autoflight and flight control systems:

- flight controls in normal law:
  - alpha protection (Alpha Prot), and
  - alpha maximum (Alpha Max).
- flight controls in alternate law:
  - stall warning.

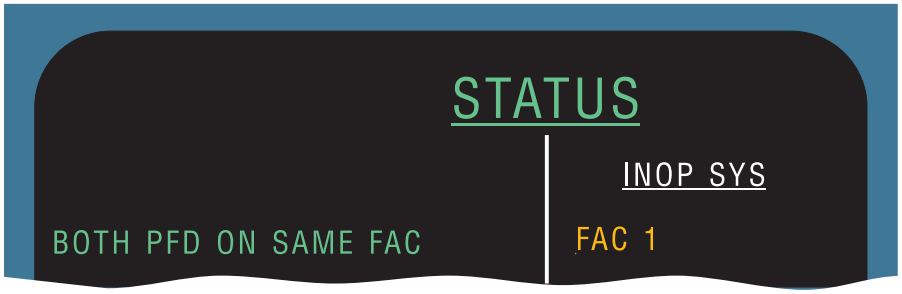
The FACs also compute the alpha floor speed. This speed is not depicted but normally occurs between alpha prot and alpha max (refer to chapter 27, Flight Controls, for additional information). Example airspeed indicator displays are shown below.



Flight Augmentation Computers (FACs) (continued)

FAC Failures

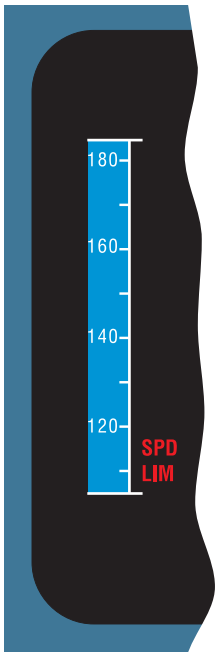
Speeds computed by FAC 1 are normally displayed on the captain's PFD. FAC 2 speeds are normally displayed on the first officer's PFD. If a FAC has failed, the other FAC automatically crosses over. A FAC failure generates an ECAM message, as shown below.



10/97 F220041C

When both FACs are inoperative, computed speeds are not displayed on the PFD airspeed indicators.

In addition, a red SPD LIM flag is displayed on the PFD, and all related flight envelope protections are inoperative.



10/97 F220042C

Alpha Floor

The FAC calculates the alpha floor angle of attack and sends the signal triggering alpha floor (See Autoflight, chapter 22).

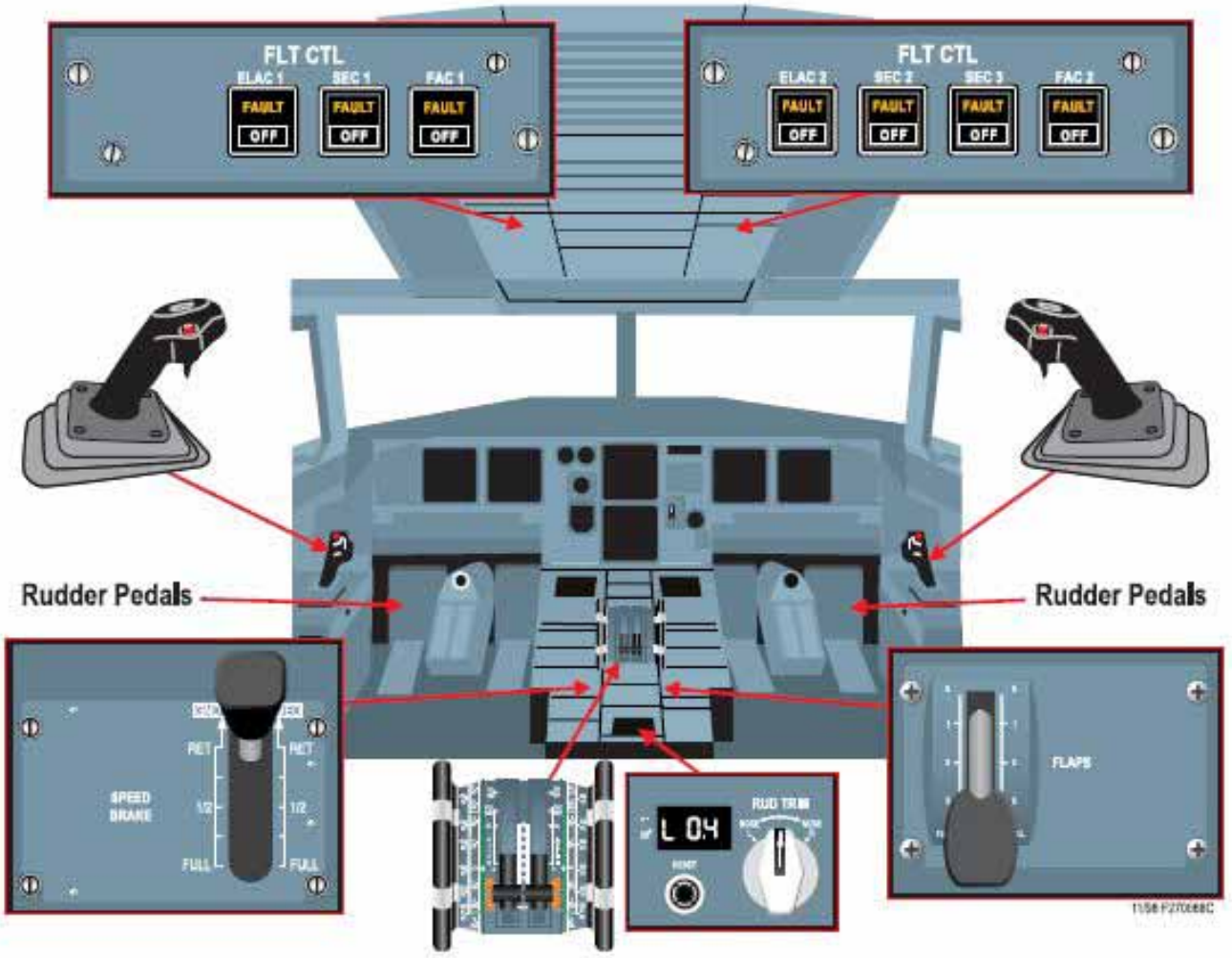
Intentionally Left Blank

Controls and Indicators

Location of Controls and Indicators

Location

Controls and indicators associated with the flight control system are located throughout the cockpit as shown below.



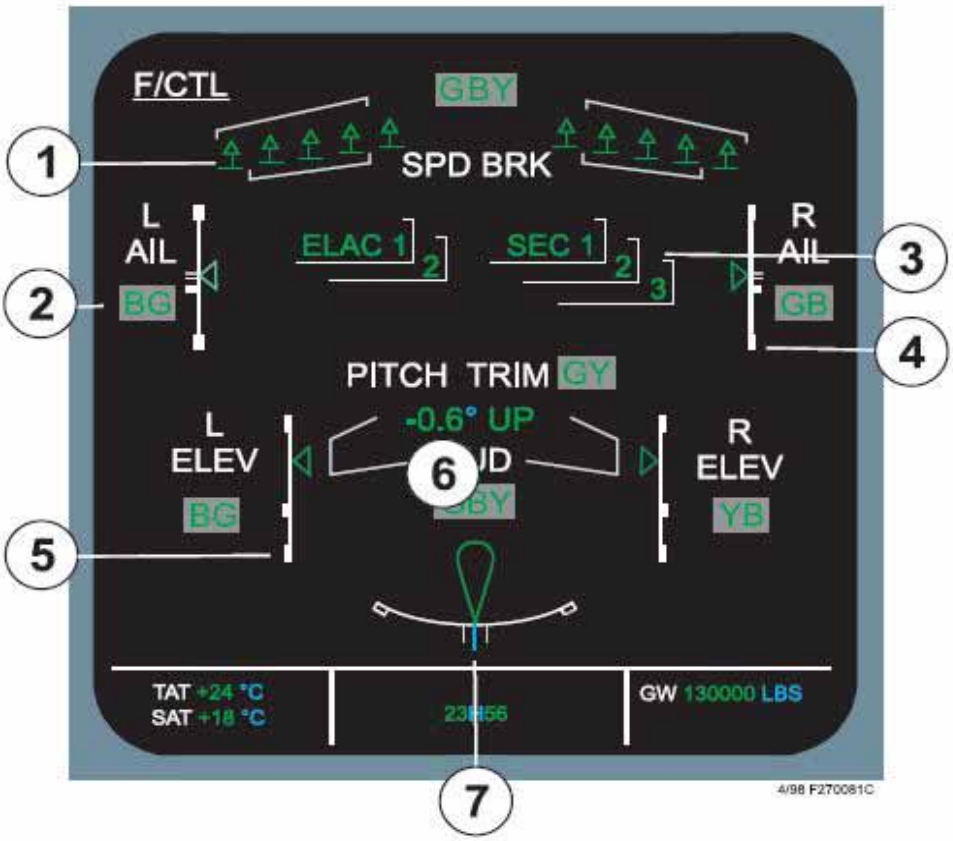
ECAM F/CTL Page

ECAM F/CTL Control Page

The ECAM F/CTL (SD) page appears when manually selected from the ECAM control panel. It automatically appears if a flight control abnormal occurs.

During taxi prior to takeoff, the flight control page automatically appears for a few seconds when a sidestick is moved, or the rudder pedals are significantly deflected.

Note: This page will not automatically appear after engine start unless the engine mode selector has been returned to NORM.



ECAM F/CTL System Display Page (continued)

1 Spoiler and Speed Brake Indications

The symbols are green when the spoilers are operational. The symbols are amber when there is a spoiler fault with the respective surface. The number of the affected spoiler is displayed in amber when a retracted spoiler is determined to be faulted.

An X replaces the spoiler symbol when the flight computers cannot determine the status of the spoiler surface, or when the corresponding SEC is inoperative.

These indications are also displayed on the WHEEL page.

2 Hydraulic System Pressure Indications

Flight control hydraulic servojacks, or servos, for each control surface are depicted on this page by a letter G for the green system, Y for the yellow system, or B for the blue system. When a hydraulic system is operating normally the letter is displayed in green. The hydraulic system letter changes color to amber if the respective hydraulic system has failed.

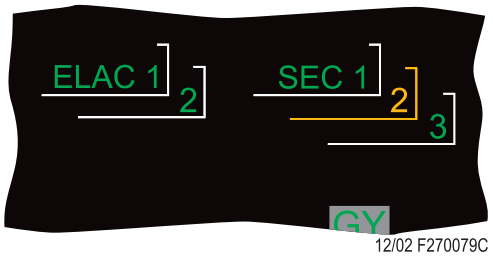
The hydraulic system letters are positioned directly adjacent to the flight control symbols, and represent the hydraulic systems which provide power for each of the servos that move the flight control surfaces. If the flight control computer for an ELAC servo has failed or has been selected off, an amber half-box is shown around the respective hydraulic system letter, indicating that the servo is inoperative.

A flight control servo requires both hydraulic pressure and a functioning flight control computer to operate. Except for the spoiler panels, every flight control surface has at least two servos. The flight control surface will operate as long as at least one servo has hydraulic power and an operational computer. In the diagram below, ELAC 1 and the green hydraulic system have failed. The right aileron will operate. The left aileron is inoperative.

ECAM F/CTL Page (continued)

(3) ELAC/SEC Indication

The indication is green if the computer is operating normally. It becomes amber if an ELAC or SEC fails. Each box represents a separate ELAC or SEC. The boxes are normally grey, but turn amber with an associated ELAC or SEC failure.

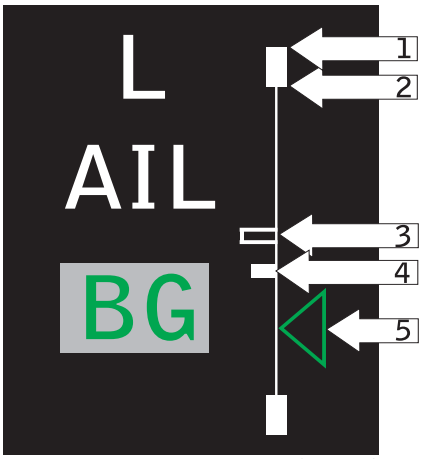


12/02 F270079C

(4) Aileron Position Indication

The aileron position indicator is comprised of a white scale that shows the range of aileron deflection and a green index:

- Maximum aileron deflection (flaps up)
- Maximum aileron deflection (flaps extended)
- Neutral aileron position with the flaps up
- Neutral aileron position with the flaps extended
- Current aileron position index



12/98 F270064C

The aileron position indicators change to amber when both the green and blue hydraulic system pressures are low. The position indicator is replaced by two amber Xs when the flight control computers cannot determine the position of that aileron. This indication also occurs when both ELACs have failed or have been selected OFF.

(5) Elevator Position Indication

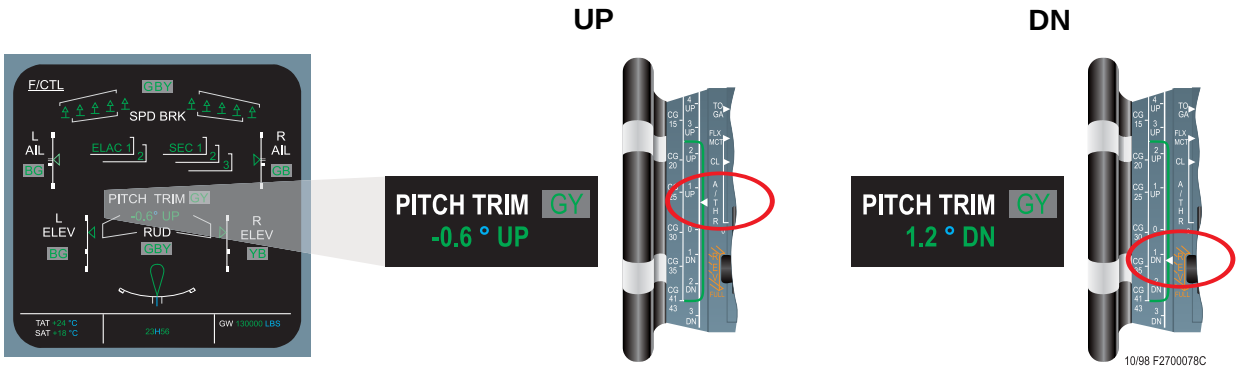
The elevator position indicator is comprised of a white scale that shows the range of elevator deflection and a green index.

The position indicator changes color to amber when both the associated hydraulic systems are unable to provide hydraulic pressure. The position indicator changes to two amber Xs when flight control computers cannot determine the status of that elevator. This indication occurs when both ELACs and SECs 1 & 2 have failed or have been selected OFF.

ECAM F/CTL Page (continued)

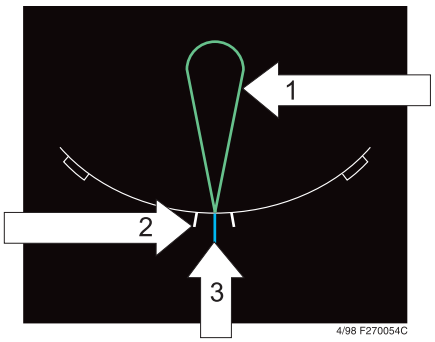
6 Pitch Trim Position Indication

The PITCH TRIM label normally appears white, but changes to amber in the event that the pitch trim is jammed. G and Y are displayed in green if the hydraulic system pressures are normal, but change to amber if low pressure is detected. A negative sign (-) is displayed to the left of the digital display of pitch trim, along with the letters UP to the right of the digital display when nose up trim has been selected. The letters DN appear behind the digital readout when a nose down trim has been selected.



7 Yaw Control Indications

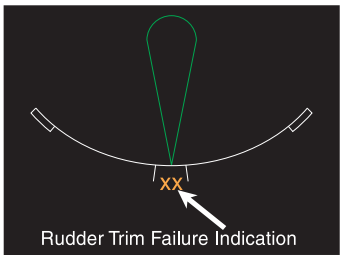
The display shows the full range of movement of the rudder.



1. The rudder position display is normally green. If all three hydraulic systems have low pressure the rudder symbol, as well as the scale, appear amber.
2. The rudder travel limiter indication is permanently positioned to show the fully restricted rudder travel limit in effect when operating at high speeds.
3. The rudder trim position display is normally blue. It changes to amber if the rudder trim reset fails.

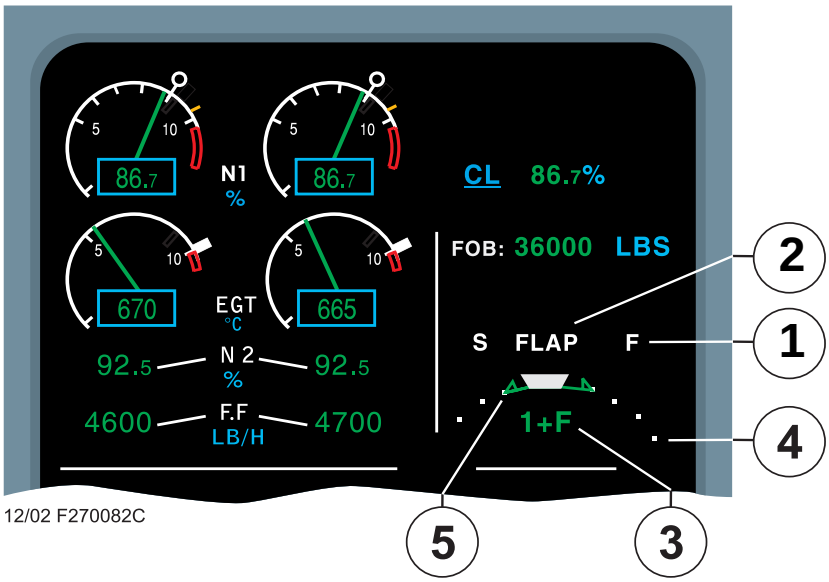
Two amber Xs are displayed when rudder trim is no longer available.

This indication will also occur when both FACs have failed or have been selected OFF or if the rudder trim sensors have failed.



E/WD Display

Diagram



12/02 F270082C

(1) S and F

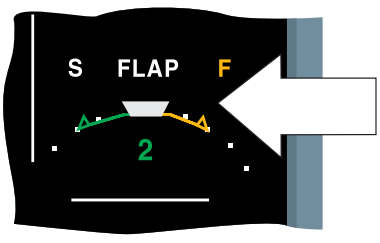
The S indicates the slat side of the display and the F indicates the flaps.

These letters are normally green but turn amber if a failure has occurred causing the slats or flaps to be inoperative.

(2) FLAP Indication

The FLAP indication is displayed when the slats or flaps are not fully retracted. The indication is:

- white when the selected position is achieved
- blue when the flaps or slats are in transit
- amber if:
  - the required hydraulic system loses pressure
  - the wing tip brakes are applied
  - there is a fault in the slats or flaps



8/98 F270083C

The slat (S) or flap (F) indication changes to amber if the slats or flaps are inoperative, either due to a loss of hydraulic pressure or computer control.

In the example shown, the slats (green) will function and the flaps (amber) have failed.

E/WD Display (continued)

3 Flap Lever Position

Possible indications include:

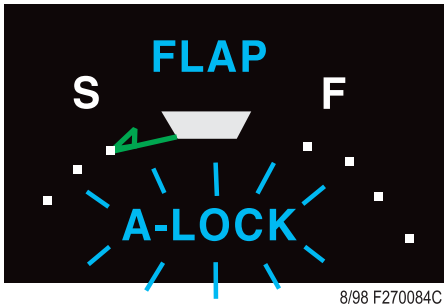
- Blank - position 0 is selected (slats and flaps are up)
- 1 + F - slats and flaps are set to 1 on the ground, or when retracting flaps from position 2 or greater in flight
- 1 - slats only (position 1 selected from 0 in-flight)
- 2 - flaps and slats set to 2
- 3 - flaps to position 3 and slats stay at position 2
- FULL - flaps and slats fully extended

When a clean configuration is reached, only the side view of the wing is displayed, with the slats and flaps retracted.

The slat and flap position indications are green when the selected position is achieved. The indications are displayed in blue during transit.

The message S LOCKED or F LOCKED appears in amber, with an associated ECAM caution, when an asymmetry or runaway has caused the wing tip brakes to be applied

The message A-LOCK pulses, in blue, when the slat alpha/speed lock function is active.



8/98 F270084C

4 Selectable Position Indications

The small white squares indicate a selectable slat or flap position. They are not shown when the airplane is in the clean configuration.

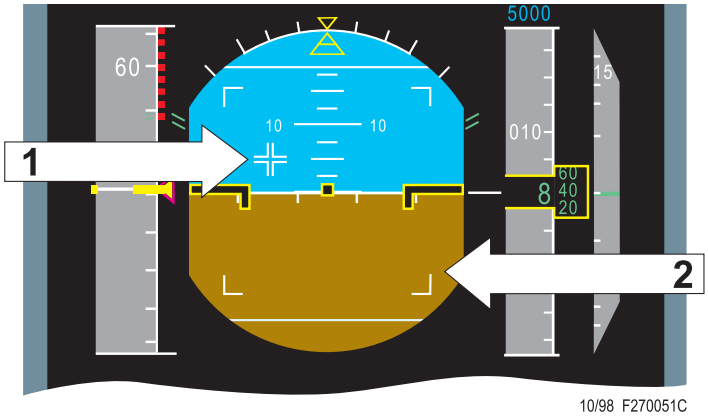
5 Actual Position Indication

The small green triangles indicate the actual slat or flap positions. The triangles turn amber if a failure has occurred causing the respective slats or flaps to be inoperative.

The symbols remain green while the slats or flaps are in transit. The selected slat and flap positions are depicted as blue triangles until the selected position is achieved.

PFD

Attitude Indicator

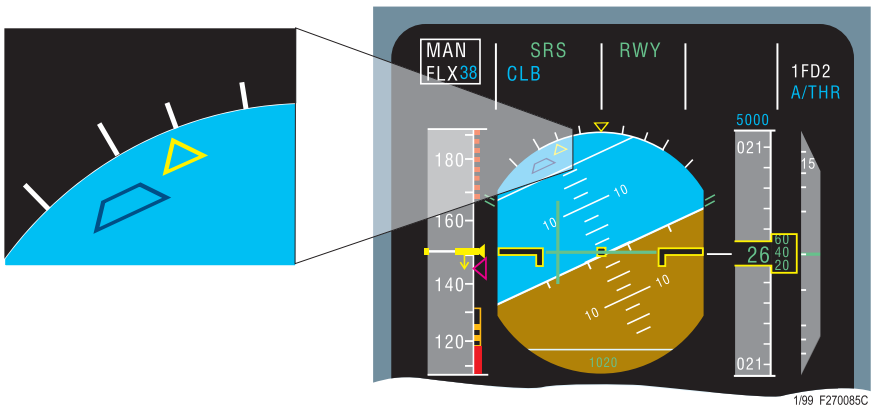


The stick position indicator is displayed in white on the captain's and first officer's PFDs. This display is only available on the ground with an engine running.

1. Combined captain/first officer stick position.
2. The white boxes represent the maximum stick deflections.

Caution: *This display cannot be used for flight control checks. It only displays the combined stick input, **not** the actual flight control positions. This display does not provide an indication of all flight control failures. The ECAM F/CTL page must be used for flight control checks.*

Sideslip Indicator



A combined bank and sideslip indicator displays the current bank angle with the yellow triangle at the top of the index.

If an engine fails, the sideslip indicator (located at the bottom of the bank index) prompts the pilot to apply enough rudder for coordinated flight and optimum climb performance. In the example above, additional left rudder is required. If the engine failure occurred with the flaps extended, the sideslip indicator changes from yellow to blue.

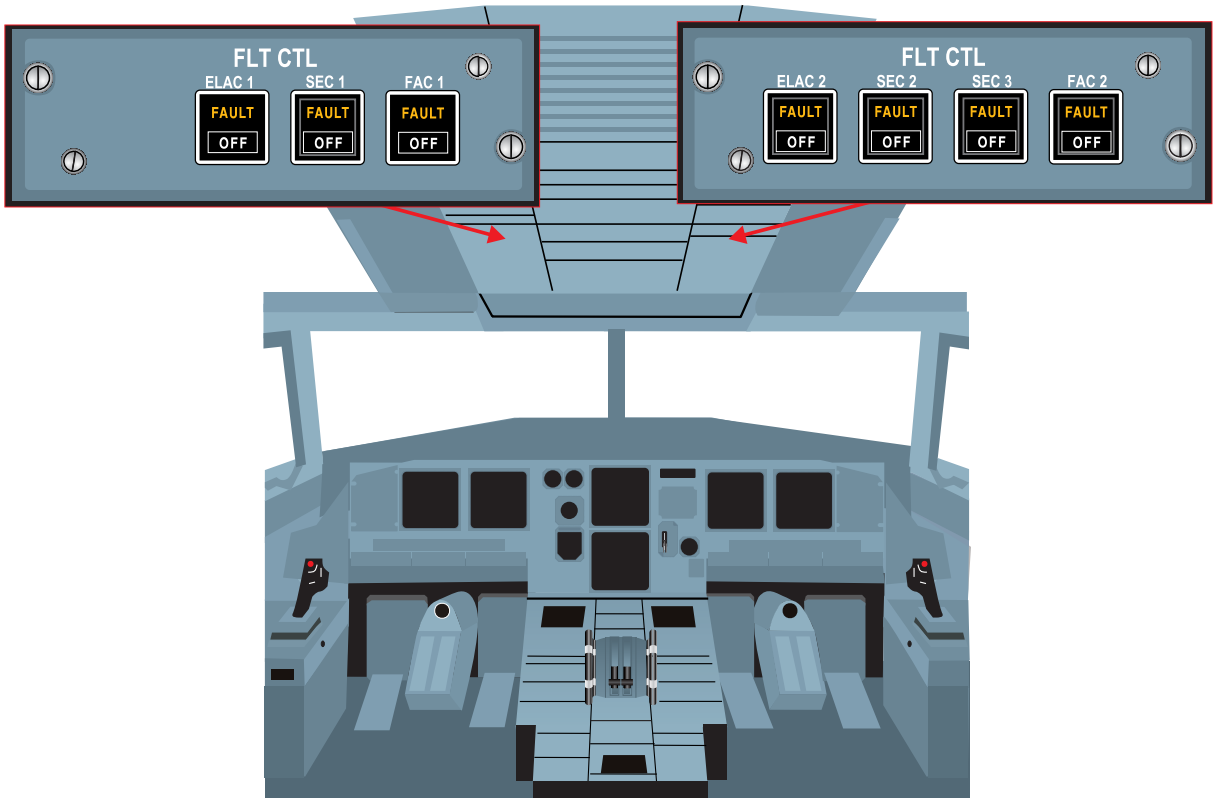
FLT CTL Panels

Flight Control (FLT CTL) Computers

During normal operation, all seven FLT CTL computers function in either an active or standby capacity. The normal configuration of the pbs is ON (lights out).

The panel on the left overhead contains three FLT CTL pbs: ELAC 1, SEC 1, and FAC 1. In the emergency electrical configuration, these three flight control computers remain operative, except that FAC 1 becomes inoperative when the aircraft electrical supply is in a batteries only configuration.

The right overhead panel contains ELAC 2, SEC 2 and 3, and FAC 2. These flight control computers are not electrically powered during an emergency electrical configuration. Electrical power to ELAC 2 is restored during the emergency electrical configuration when the aircraft electrical supply is in a batteries only configuration.



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Note: Pilots are not required to memorize the specific results of single or multiple failures of the ELACs, SECs, or FACs as listed in the following paragraphs. This information is provided primarily for reference for other documents (QRH, MDM, etc.).

FLT CTL Panels (continued)

ELAC 1 (2) pb

The ELAC pbs control the operation of the elevator aileron computers

The ELAC pbs have three possible indications..

8/98 F270087C

ON (lights out): The ELAC is on and is operating normally.

FAULT: The ELAC is inoperative. The FAULT light will illuminate while the ELAC is performing its built in self test during initial power up or following a reset. The FAULT light is inhibited with the pb selected OFF.

OFF: The ELAC has been selected OFF. Cycling the switch to OFF and then back ON resets the computer.

With one ELAC failed or selected off:

- both ailerons operate normally
- all other functions are picked up by the remaining ELAC

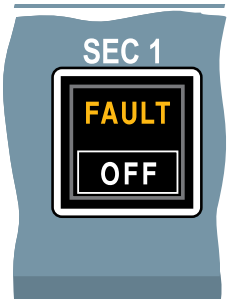
With both ELACs failed or selected off:

- flight control laws degrade from normal law to alternate law
- both ailerons are inoperative and roll control is provided by the spoilers
- both autopilots are inoperative

SEC 1 (2) (3) pb

The SEC pbs control the operation of the Spoiler Elevator Computers

The SEC pbs have three possible indications.



8/98 F270088C

ON (lights out): The SEC is on and is operating normally.

FAULT: The SEC is inoperative. The FAULT light is inhibited with the pb selected OFF.

OFF: The SEC has been manually selected OFF. Cycling the switch to OFF and then back ON resets the computer.

With one or two SECs failed or selected OFF:

- the spoiler panels associated with the failed SEC(s) are inoperative
- speed brakes and ground spoilers have reduced effectiveness

With three SECs failed or selected OFF:

- flight control laws degrade from normal law to alternate law
- the speed brakes and all spoilers are inoperative and roll is controlled by ailerons only

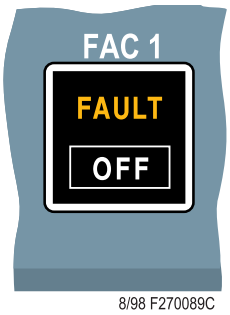
Note: The SECs control the engine reversers. Multiple SEC failures will result in the loss of one or both engine reversers.

FLT CTL Panels (continued)

FAC 1 (2) pb

The FAC pbs control the operation of the flight augmentation computers. Unlike the ELAC and SEC pbs, the FACs are electrically powered with the pb in either position

The FAC pbs have three possible indications.



8/98 F270089C

ON (lights out): The FAC is on and is operating normally.

FAULT: The FAC is inoperative. The FAULT light illuminates amber and is accompanied by an ECAM caution, if a FAC failure is detected. The FAULT light extinguishes when the pb is selected OFF.

OFF: All rudder functions (yaw damping, rudder trim, turn coordination, rudder limiting) associated with that FAC have been selected OFF. The associated yaw damper is disabled (e.g., if the FAC 2 pb is off, yaw damper 2 is off). The other FAC, if operative, provides all rudder functions without degradation.

Cycling the switch to OFF and then back ON resets the computer.

With one FAC failed or selected OFF:

- the other FAC takes over all FAC functions and aircraft operations are essentially unaffected
- characteristic speed indications on both PFDs are provided by the remaining FAC

With both FACs failed or selected OFF:

- the flight control laws change from normal law to alternate law
- rudder control is through the rudder pedals via the mechanical connection
- rudder trim, yaw damping, and rudder limiting are lost
- both autopilots are inoperative

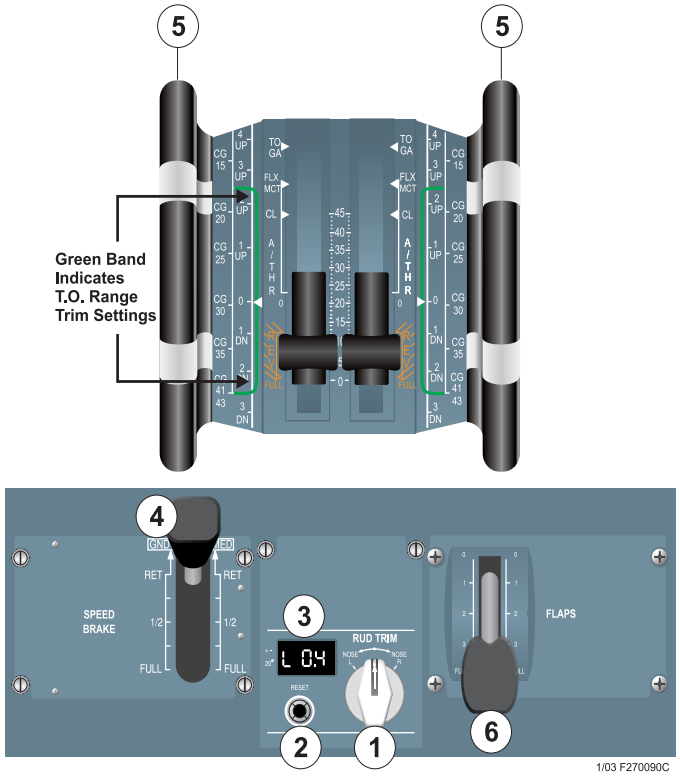
Flight Control Computer Resets

The flight control computers are sensitive to power interruptions. A FAULT indication displayed after an electrical power transient does not necessarily indicate a failure of the associated computer. In these conditions, a successful reset of the computer (in accordance with the appropriate ECAM or QRH procedure) would not be considered a computer failure. In general, flight control computer resets:

- should be performed one at a time when directed or allowed by the ECAM or QRH procedure
- should not be performed during the built-in self-test cycle after establishing electrical power

Pedestal Controls

Pedestal Diagram



(1) Manual RUD TRIM Selector

This switch is used to manually trim the rudder. The rudder pedals are displaced symmetrically when the rudder is trimmed. The switch functions are inhibited when an autopilot is engaged.

(2) RESET pb

Momentarily pressing this pb resets the rudder trim to the zero position. The switch functions are inhibited when an autopilot is engaged.

(3) Rudder Trim Position Indicator

This displays the current degree and direction of rudder trim.

Note: Due to cold soaking of rudder trim components, up to approximately 2.0 degrees of left or right rudder trim (with neutral ailerons) is a normal indication of neutral rudder trim during extended high altitude cruise flight. However, if a significant amount of rudder trim is indicated and the ailerons are also displaced from neutral, a fuel imbalance or other asymmetry may be present.

Pedestal Controls (continued)

4 Speed Brakes

This handle controls the extension of the speed brake surfaces and is labeled from RET (retract) to FULL deflection. There is no mechanical connection to the speed brakes or ground spoilers. Moving the speed brake handle aft extends the speed brakes. A detent can be felt at the 1/2 position.

Speed Brake Reset

If the speed brakes have been automatically retracted an ECAM SPD BRK DISAGREE message is displayed. To regain control of the speed brakes, the condition that caused the automatic retraction must be corrected, and the speed brake handle returned to the RET position for approximately 10 seconds.

Ground Spoilers

Automatic Ground Spoilers

Pulling up the handle when in the RET position arms the automatic spoilers for takeoff and landing. Automatic ground spoilers extend all 5 panels when deployment conditions occur. The handle does not move with spoiler deployment.

The automatic ground spoilers are not armed unless the handle is full forward (e.g., in the RET position) and up.

Manual Ground Spoiler Extension (Selection of Speed Brakes on the Ground)

Pulling the speed brake handle aft while on the ground results in the following:

- if at flaps 0 through 3, spoilers 1-4
- if at flaps FULL, spoiler pair 1 only

Caution: Manual ground spoiler extension results in less spoiler surfaces than automatic deployment.

5 Pitch Trim

Two trim wheels provide mechanical control of the THS.

Trim position is indicated in degrees and in percent CG on a scale next to the trim wheels. The normal range for takeoff is marked by a green band. The trim position is also displayed on the ECAM F/CTL page.

After touchdown, pitch trim is automatically reset to zero.

Pedestal Controls (continued)

6 Flap Handle

The flap handle, located on the center console, controls both the flaps and slats. It has 5 positions: 0, 1, 2, 3, and Full.

Position 0: Slats and flaps are retracted.

Position 1: Selects one of two different configurations depending on when it isselected:

- on the ground, the slats and flaps extend to position (1 + F)
- in flight from the clean configuration, only the slats extend to position 1
- in flight from flaps 2 or greater (i.e., during a go-around), the slats and flaps both retract to position (1 + F)

Position 2: Used as a maneuvering configuration.

Position 3: Used for takeoff, landing, abnormal or maneuvering.

Position FULL: Used for normal landing.

Note: The slats do not move when the flap handle is moved between positions 2 and 3.

To move the flap handle, the pilot must lift upward on a collar and then move the handle fore or aft as required. Stops are located at positions 1 and 3 which force the pilot to re-cycle the collar to move the handle through those positions.

The five flap handle positions correspond to the surface positions as shown.

Position	SLATS (degrees)	FLAPS (degrees)	ECAM Indication
0	0	0	
1	18	0	1
		10	1 + F
2	22	15	2
3	22	20	3
FULL	27	35	FULL

The slat positions are marked on the engine pylon. The flap positions are labeled on the flap surface and are visible when the flaps are extended. These labels can be viewed best from the cabin windows identified with a black triangle.

Warning

Managed speeds are computed using the flap handle position, not the actual position of the flaps/slats. This may result in an unsafe speed if managed speed is engaged with jammed flaps or slats.

Sidestick

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AP Disconnect/ Priority pb

Pressing the pb momentarily disconnects the autopilot(s). If the pb is held, the other sidestick is deactivated.

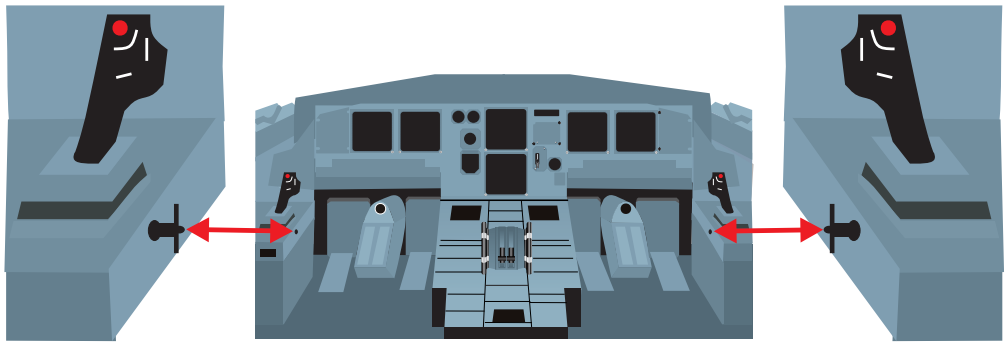
Holding the pb for more than 40 seconds latches the sidestick priority and the pb may be released without losing priority.

Note: A deactivated stick can be reactivated at any time by pressing its takeover pb. The last pilot to press his/her takeover pb has priority.

Note: A deactivated stick will trigger the takeoff CONFIG warning when takeoff thrust is applied, or the takeoff CONFIG warning is tested.

Sidestick Maintenance Safety Pins

During ground maintenance, a safety pin can be installed which prevents sidestick movement. When the pin is removed, a small metal plate covers the opening. The cover plate cannot be installed with the pin in place. Each sidestick can be pinned independently. Installation and removal of this pin is normally a maintenance function only.



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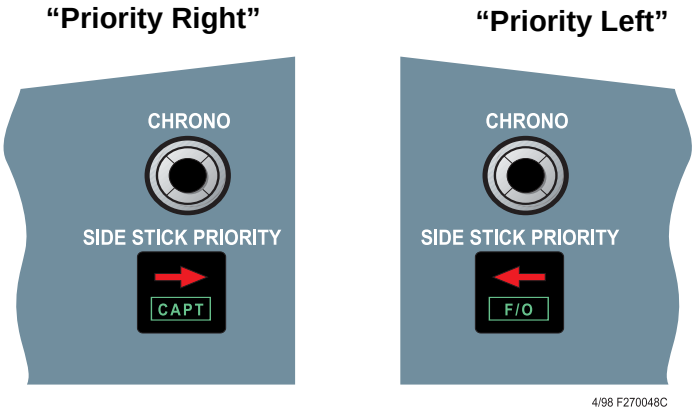
Sidestick Priority Lights

Sidestick Priority Audio Message

When priority is taken, a synthesized PRIORITY LEFT or PRIORITY RIGHT audio message is generated.

Note: When both sidesticks are simultaneously moved around their axis, a DUAL INPUT audio message will be generated and the green CAPT and F/O lights will flash.



Red arrow:

- illuminates in front of the pilot whose sidestick has been deactivated and points towards the pilot whose has taken priority. Remains illuminated:
  - as long as the respective takeover pb is depressed or
  - the takeover pb is depressed for 40 seconds or more
- extinguishes if the other pilot has recovered priority or a takeover pb is released prior to 40 seconds.

CAPT or F/O green light:

- illuminates in front of the pilot who has taken priority if the opposite sidestick is not sensed in its neutral position
- in manual flight, both annunciations illuminate when both pilots are simultaneously attempting to control the aircraft
- extinguishes when the opposite stick is sensed in neutral

ECAM Memo Display Message

These flight control ECAM messages are displayed on the ECAM E/WD display.

Message	Condition
SPEED BRK	If the speed brakes are extended, the message is displayed in green. The message becomes amber in flight if one or both engines are not at idle thrust.
GND SPLRS ARMED	If the ground spoilers are armed, the message is displayed in green.

Chapter 28: Fuel

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System Description

Location of Fuel System Components

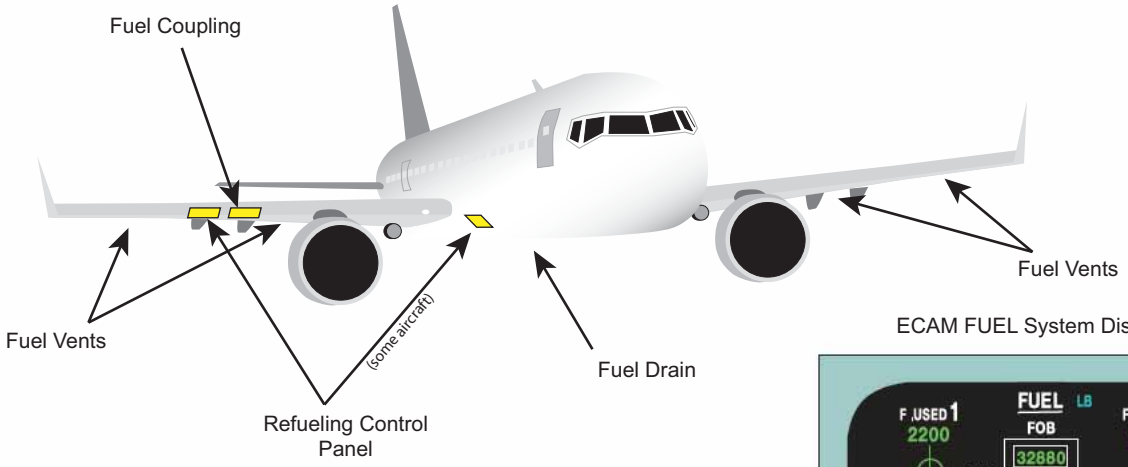
Introduction

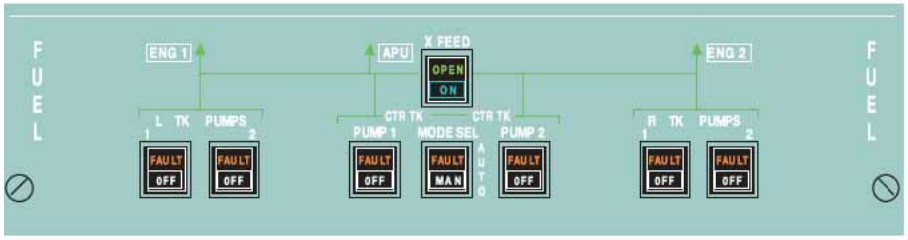
The fuel system is designed to carry and deliver fuel to the aircraft engines and APU. The diagram below illustrates the major components of the fuel system. The fuel tanks, pumps, and valves are visible only through electronic representation on the ECAM system.

System Breakdown

The fuel system is composed of:

- three fuel tanks,
- six fuel pumps,
- fuel valves,
- fuel level and quantity sensors,
- refueling control panel and fuel coupling, and
- fuel vents, drain, and surge tanks.





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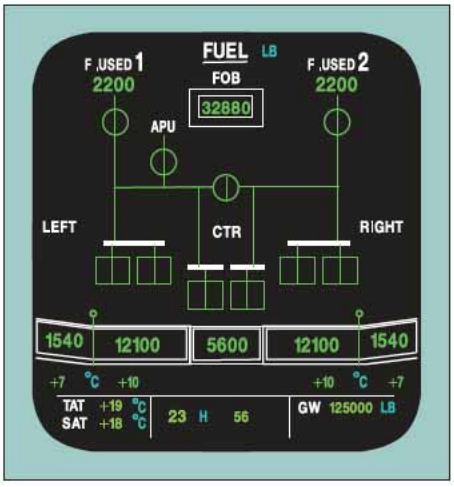
Cockpit Fuel Overhead Panel

ECAM FUEL System Display Page



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Fuel Flow

Description

The flow of fuel from the tanks to the engines is illustrated with the diagram below.

Diagram #1 shows the flow of fuel from the tanks, through the pumps, to the engines via valves, which can be opened and closed. Additionally, crossfeed capability exists to re-direct fuel.

Diagram #2 shows how the same flow is illustrated on the ECAM FUEL system display page. Starting at the bottom of the page, the tanks are illustrated, then the pumps. Next the valves are illustrated, then at the top of the page the indication of fuel used by each engine.

Flow Diagrams

Diagram #1

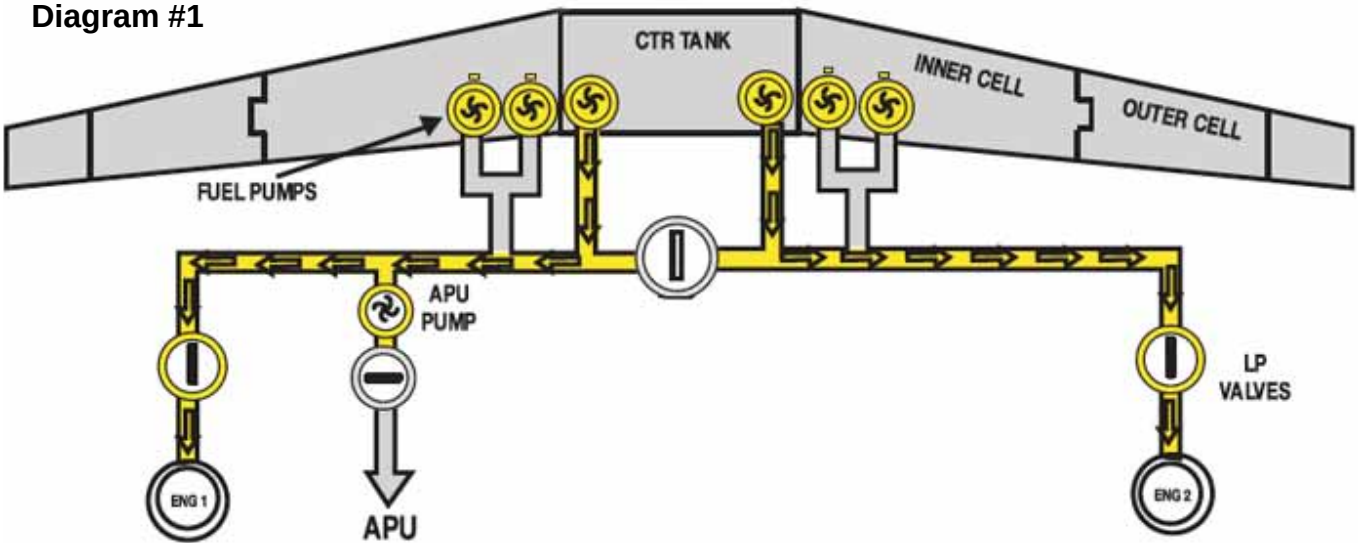
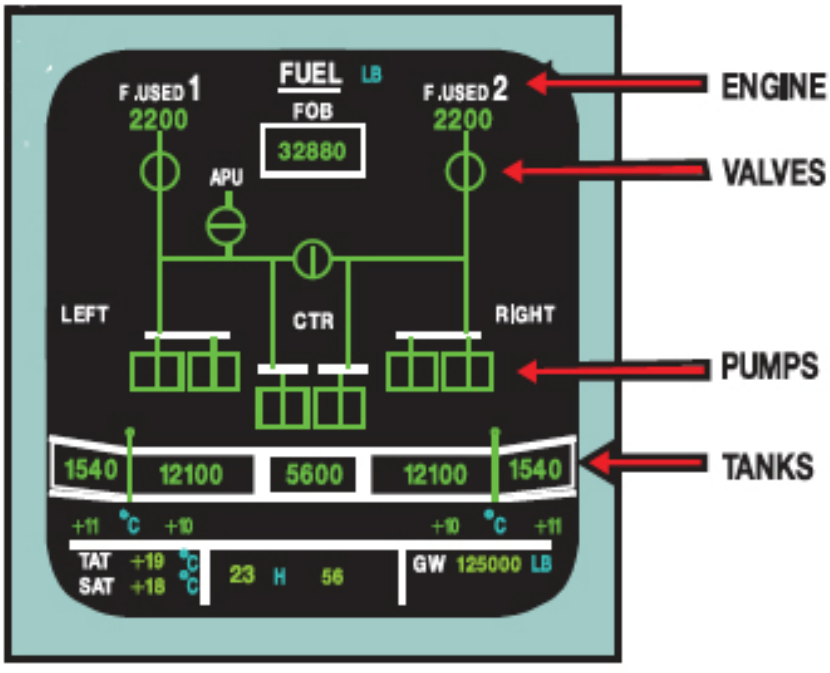


Diagram #2

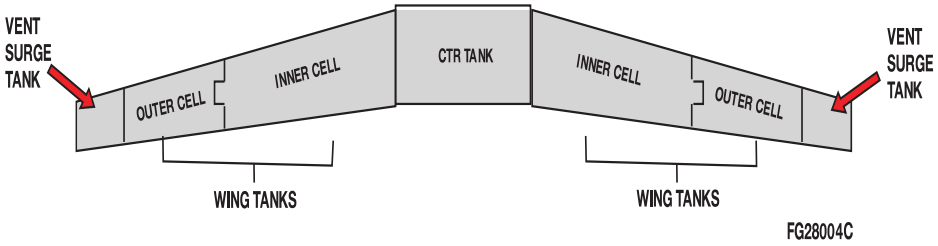


Fuel Tanks

Location

The fuel tanks are located in the wings and the wing center section in the fuselage. There is also a vent surge tank located in the outer section of each wing.

This diagram shows the location of the fuel tanks.



Capacity

The A319/A320 have a total fuel capacity of approximately 42,000 pounds. Each wing tank holds approximately 12,200 pounds in its inner cell and approximately 1,500 pounds in its outer cell. The center tank holds approximately 14,500 pounds.

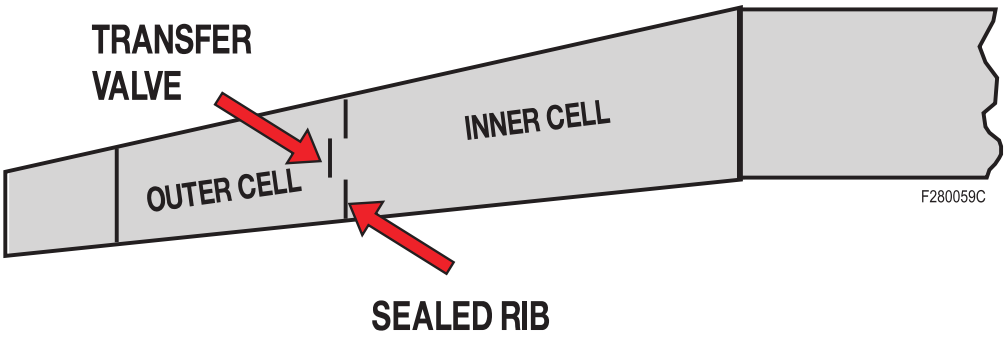
Normal fuel distribution requires the wing tanks to be filled to capacity (approximately 27,500lbs) before any fuel is placed in the center tank.

The FUEL system page of the ECAM displays the individual quantity of each respective tank.

Wing Tanks

Each wing tank is divided into two cells by a sealed rib. The cells are referred to as the inner and outer cells. Within each sealed rib, a transfer valve permits fuel to gravity flow from the outer to the inner cell. Two fuel pumps are located in each inner cell.

During refueling, the outer cells are filled to capacity, fuel then over-spills into the inner cell. The outer cells can also receive fuel from surge tank overflow and Integrated Drive Generator (IDG) cooling return fuel.



Fuel Tanks (continued)

Center Tank

The center tank is the largest of the aircraft's fuel tanks. It is undivided and contains two fuel pumps. Normal fuel distribution requires the wing tanks to be full before fuel is placed in the center tank.

Under normal operating conditions, center tank fuel is consumed first whenever the slats are up (See Center Tank Fuel Pumps for further details).

Fuel Tank Inerting

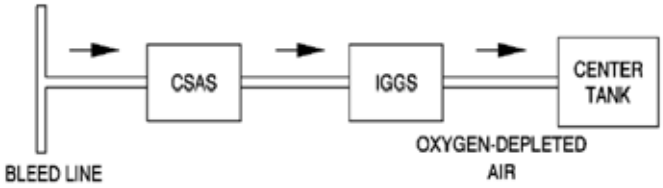
The fuel inerting process works by taking normal ambient air and replacing it with oxygen-depleted air in the fuel tank vapor space located in the center tank so that combustion cannot take place if there is an ignition source.

The Fuel Tank Inerting System (FTIS) is comprised of the following components which are installed in the belly fairing of the aircraft near the left air conditioning pack:

Conditioned Service Air System (CSAS): The CSAS conditions the engine bleed air to an acceptable pressure and temperature.

Inert Gas Generation System (IGGS): The IGGS contains an Air Separation Module that traps oxygen molecules in a series of fiber membranes which is then vented overboard.

Note: FTIS works fully independently from engine start to engine shutdown regardless of center tank fuel quantity. There are no flight deck indications or controls



Fuel Tank Venting

The fuel tank venting system prevents the over-stressing of each fuel tank structure by ensuring near ambient air pressure during fueling/defueling and, permitting over-board spillage in the event of a refuel shut-off valve failure.

Two surge tanks, located outboard of each respective wing tank's outer cell, are designed to vent each fuel tank to atmosphere and capture any over-serviced fuel. In addition, each wing tank inner cell is equipped with an over-pressure relief port.

Should a surge tank become over-filled, or an inner cell become over-pressurized, the excessive fuel and/or pressure is relieved overboard through over-pressure relief ports located on the under side of each wing. Each over-pressure relief port is secured closed by a black carbon disc which can be viewed.

A white **X** on each carbon disc indicates that the disc is intact and therefore the relief port is closed.

Note: During preflight, any visible portion of the white **X** represents an intact carbon disc.

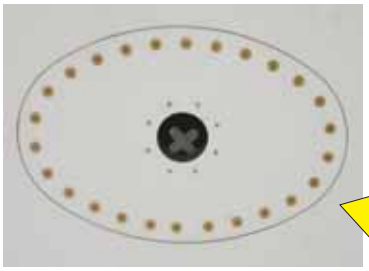
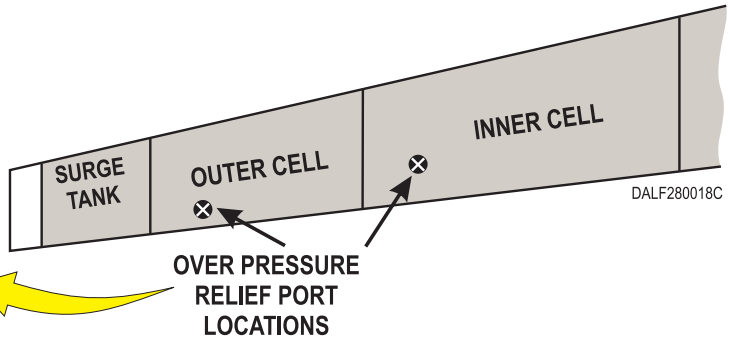


Photo of actual RELIEF PORT with Disc Intact



IDG Cooling Fuel

The engine driven integrated drive generators' (IDGs) oil system uses fuel flow for cooling. This fuel is tapped from the high pressure fuel line of the respective engine, and then is returned to the outer cell of the associated wing tank. If the outer cell is full the returning fuel overflows into the inner cell through a return spill valve.

In the event the inner cells are full and the center tank is supplying fuel to the engines, the center tank pumps will temporarily shut off to permit the wing tanks to supply the engines in order to make room for the returning fuel.

Note: There are no ECAM memo section messages associated with normal IDG cooling.

Fuel Pumps

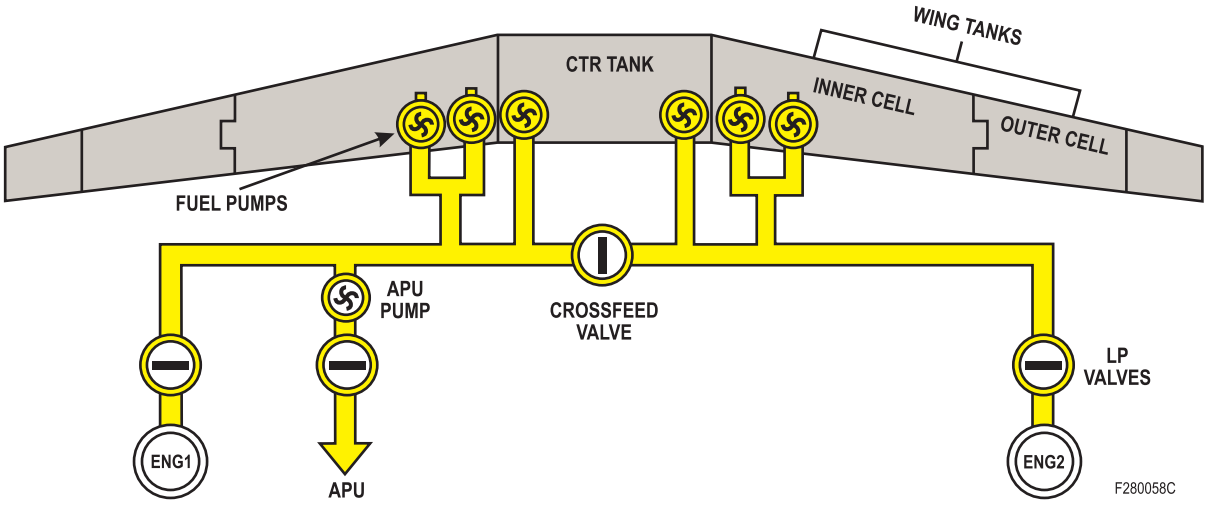
General

The fuel system is equipped with six electrically powered fuel pumps. Each pump provides fuel flow to the fuel manifold. In addition, a dedicated APU fuel pump provides fuel flow to the APU when the left manifold is not pressurized.

Location

Each fuel pump is located within a fuel-filled enclosed canister to ensure cooling and lubrication.

There are two fuel pumps located in each inner cell of the wing tanks and two fuel pumps in the center tank. The APU fuel pump is located slightly aft of the left wing trailing edge.



Wing Tank Fuel Pumps

Each wing tank fuel pump is controlled by its respective pb located on the FUEL section of the overhead panel.

When the pb is selected on (lights out), the respective pump runs continuously when electrical power is available. When selected to the OFF position, the word OFF illuminates in the pb and the respective pump is depowered.

Each wing tank fuel pump is fitted with a pressure reducing valve to allow the center tank fuel pumps to preferentially supply the engines when the center tank pumps are also operating. However, under normal conditions, wing tank fuel pumps are always used to supply fuel to the engines during takeoff and landing. (See Center Tank Fuel Pumps for further details.)

Note: Suction valves incorporated within each wing tank fuel pump permit gravity feeding of fuel to their associated engine in the event both pumps fail. Gravity feeding automatically takes place provided; the respected engine is operating, the Crossfeed valve is closed and all pumps connected to that side of the manifold are off.

Fuel Pumps (Continued)

Center Tank Fuel Pumps

The center tank pumps are controlled by their respective pbs located on the FUEL section of the overhead panel.

When the pb is selected on (lights out), the center tank pumps are capable of operating in either the manual or automatic mode. Operating mode is selected with the MODE SEL pb located between the pump pbs.

The center tank pumps are capable of operating in either the manual or automatic mode. Operating mode is selected with the MODE SEL pb located between the pump pbs.

Manual Mode

When the manual mode is selected, the word MAN appears on the MODE SEL pb. The center tank pumps operate continuously whenever they are selected on and electrical power is available.

Automatic Mode

When the MODE SEL pb is in AUTO (lights out) and the pumps are selected on with fuel in the center tank, the automatic operating logic becomes active. The center tank pumps will:

- Perform a momentary self-test during second engine start.
- Operate with center tank fuel until the slats are extended. When slats are extended, the pumps stop operating, except during the self-test. When slats are retracted, the pumps resume operation.
- Continue to run for a short period when the center tank becomes empty, then automatically shut off.
- Temporarily shut off in the event the inner cells are full and the center tank is supplying fuel to the engines. This will permit the wing tanks to supply the engines in order to make room for returning IDG cooling fuel.

Note: The fuel system is normally operated with the center tank pumps in the AUTO Mode (lights out) regardless of center tank fuel quantity.

The message CTR TK FEEDG appears on the memo section of the E/WD when center tank pumps are pressurizing the fuel manifold.

When selected off, OFF appears on the pb and the respective pump is depowered.

Note: Unlike Wing Tank pumps, the Center Tank pumps are not equipped with suction valves therefore gravity feeding of center tank fuel is not possible.

APU Fuel Pump

The APU has a dedicated fuel pump that operates automatically when the left fuel manifold is not pressurized and the APU MASTER switch is “ON.” There are no flight deck controls for the APU fuel pump.

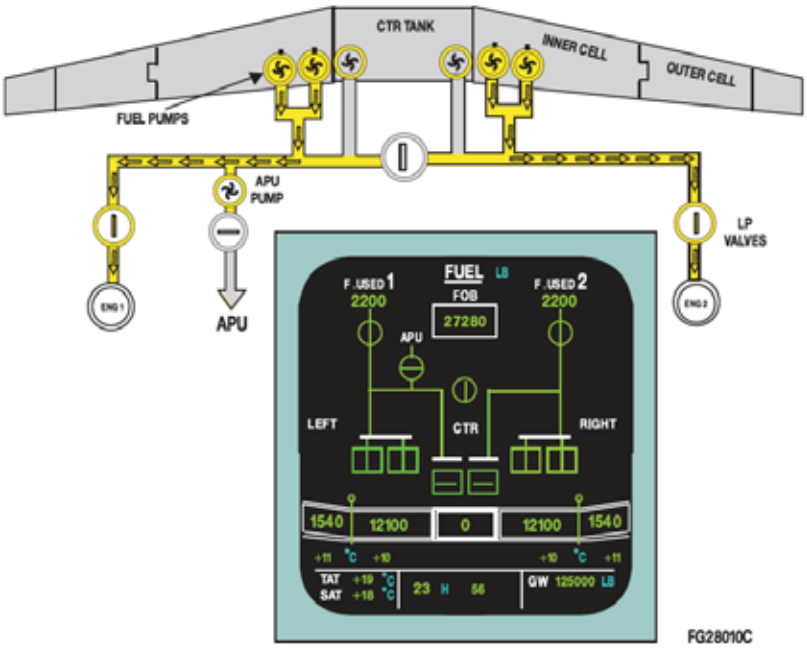
Note: The APU fuel pump is capable of being power by the aircraft batteries.

Fuel Feed

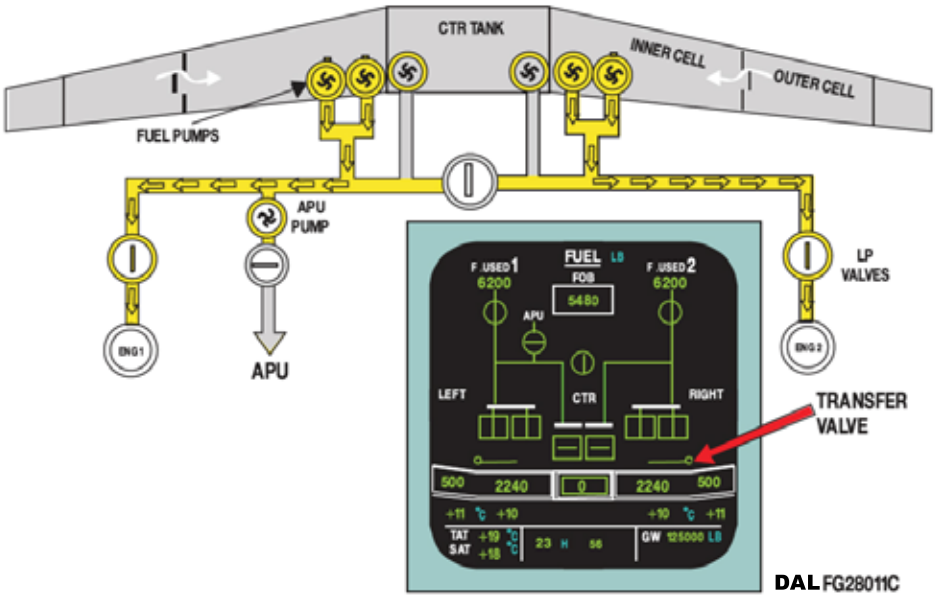
Empty Center Tank

With a total fuel load of less than approximately 27,500 lbs, the center fuel tank will be empty. Although empty, all associated center tank pump pbs as well as wing tank pump pbs are placed in a lights out configuration. In this scenario, the center tank pumps will not operate and the wing tank pumps will supply the engines. When a predetermined low level is reached in an inner cell, both transfer valves open and fuel from the outer cell flows into the respective inner cell.

Example: Wing tank pumps are supplying respective engines from the inner cells. Notice that the center tank pumps are off and the crossfeed valve is closed.



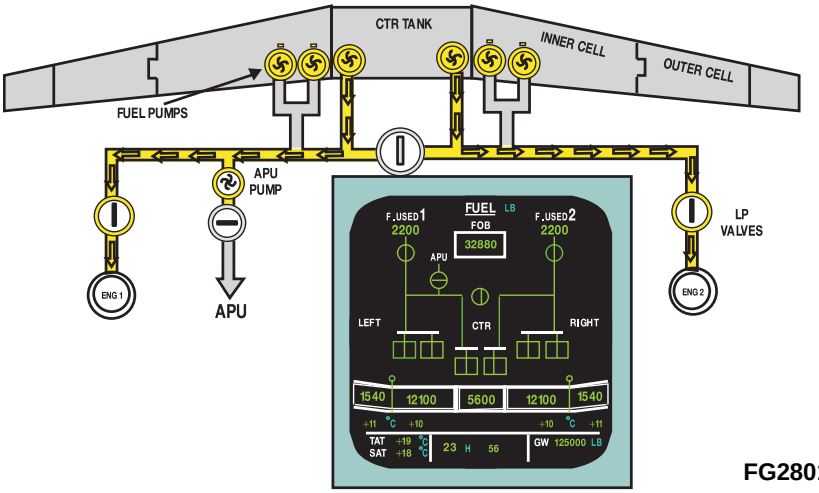
Example: Transfer valves are open and fuel is transferring from the outer cells to the inner cells.



Fuel Feed (continued)

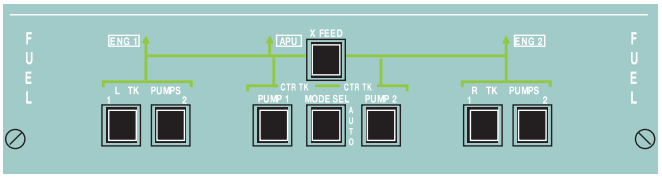
Fuel In Center Tank

With a fuel load of greater than 27,500 lbs, the additional fuel is placed in the center tank. Again, all associated center tank pbs as well as wing tank pbs are placed in a lights out configuration. The center tank pumps supply the engines when the slats are retracted. When the center tank becomes empty, the wing tanks will then supply the engines.



FG28012

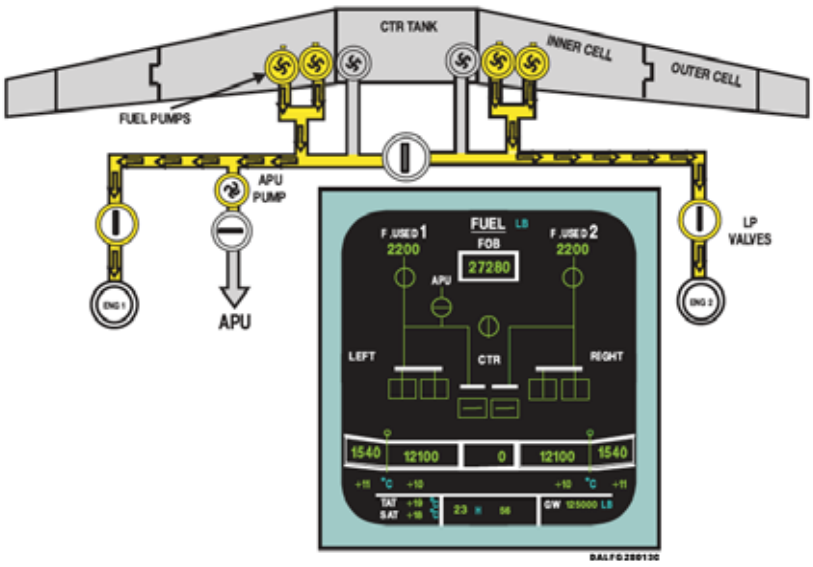
Lights Out Configuration



FG28012C

Slats Extended/ Overfill Condition

When in the condition illustrated below, the center tank pumps will shut off whenever the slats are extended, in which case the wing tanks feed the engines. This assures the availability of gravity feeding in the event of a loss of electrical power during a critical phase of flight. The center tank pump(s) also shut off if an overfill condition is detected in a outer cell due to IDG cooling return fuel.

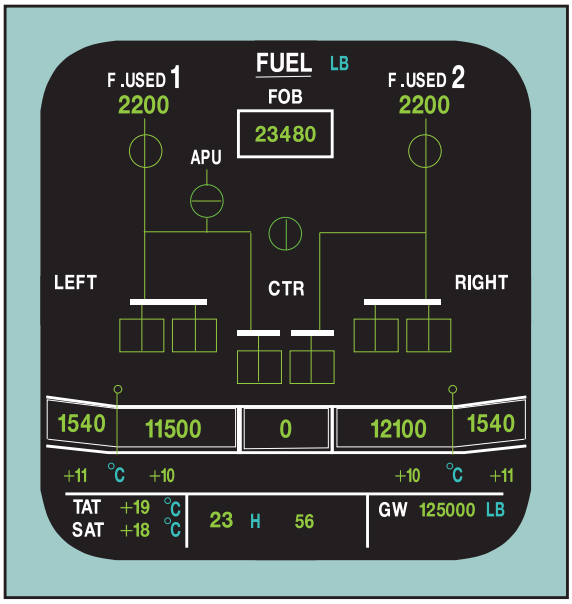


Fuel Feed (continued)

Center Tank/Low Level Condition

After the center tank is empty, the center tank pumps continue to run for a short time and then shut off. When the center tank is empty, wing tank fuel is used.

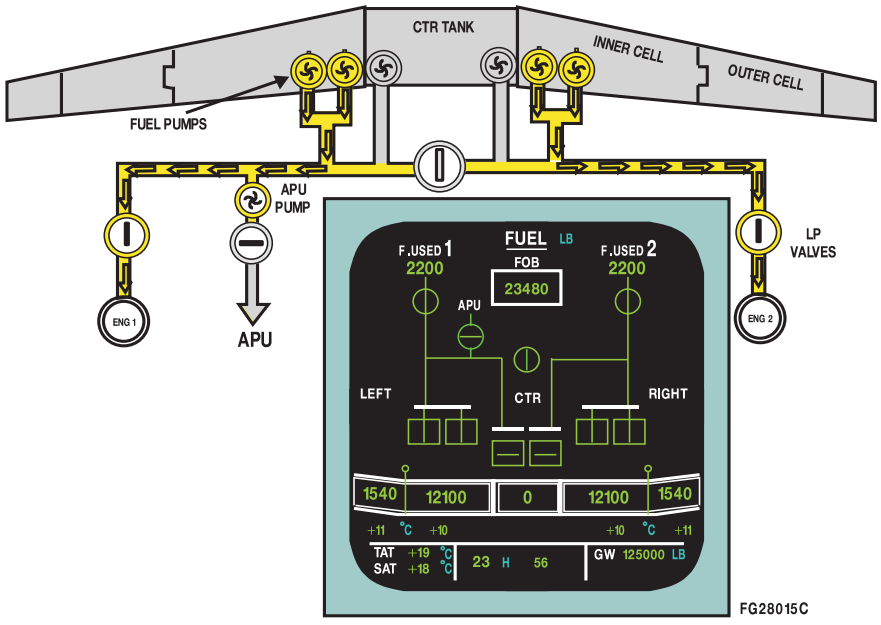
The ECAM FUEL system display page shows the center tank configuration after slat retraction and prior to auto shut off for low level.



FG28014C

Inner Cell Wing Tank Fuel Use

If the center tank is empty, wing tank fuel is used.

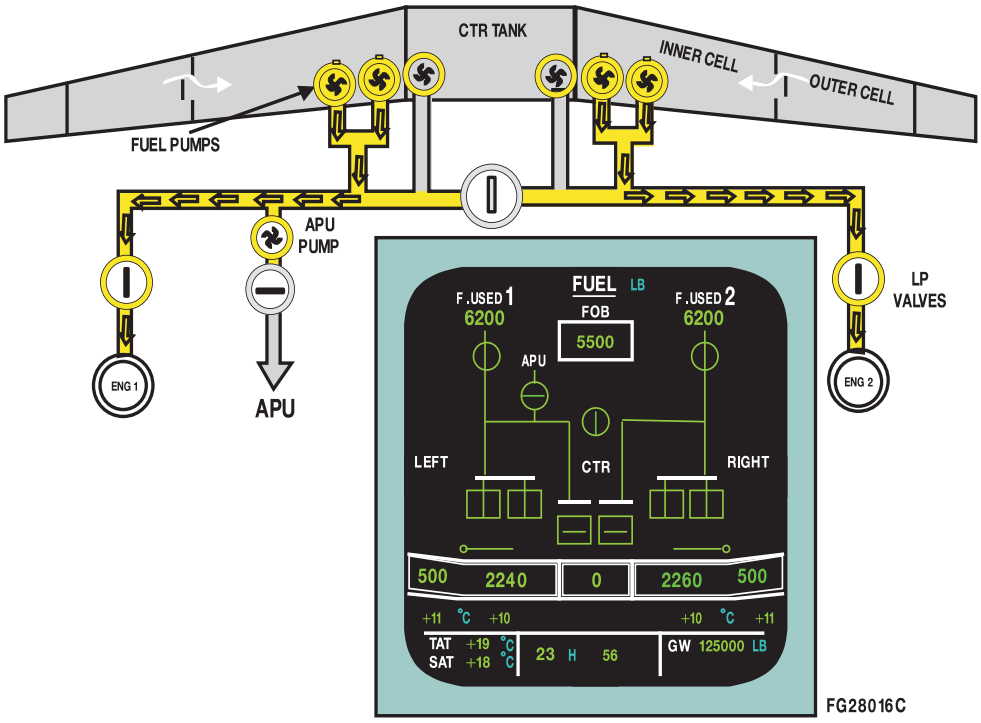


FG28015C

Fuel Feed (Continued)

Outer Cell Fuel Transfer

When the quantity in either wing tank inner cell reaches approximately 1650 lbs, fuel is automatically transferred from the outer cells to the inner cells of each wing tank by the opening of Transfer Valves.:



Fuel Valves

General

There are five fuel system valves installed in the A-320. Each has a different purpose. They are:

- gravity feed valves
- crossfeed valve
- pressure reducing valves
- low pressure (LP) engine fuel valves
- transfer valves

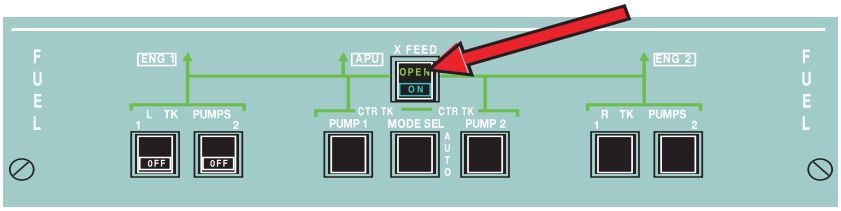
Gravity Feed Valves

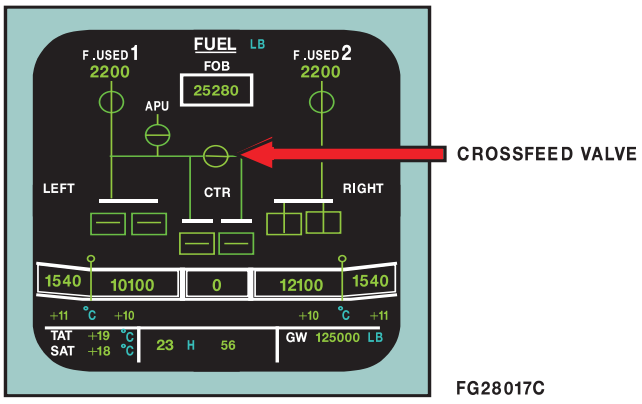
The gravity feed valves are located in the wing inner fuel cells. These valves allow the engines to feed without fuel pump pressure. Sufficient positive fuel pressure can be maintained below approximately 15,000 feet if negative load factors are avoided. Gravity feed of center tank fuel is not possible.

Crossfeed Valve

The crossfeed valve separates the left and right fuel manifolds. When opened it permits the entire manifold to be pressurized by any fuel pump. The crossfeed valve is controlled by it's respective pb located on the FUEL section of the overhead panel. The word OPEN appears on the pb when the valve is in the commanded open position. In addition, the message FUEL X FEED appears on E/WD memo section. The pb is lights out when the valve is in the closed position.

Note: The crossfeed valve is incapable of automatic opening or closing.





FG28017C

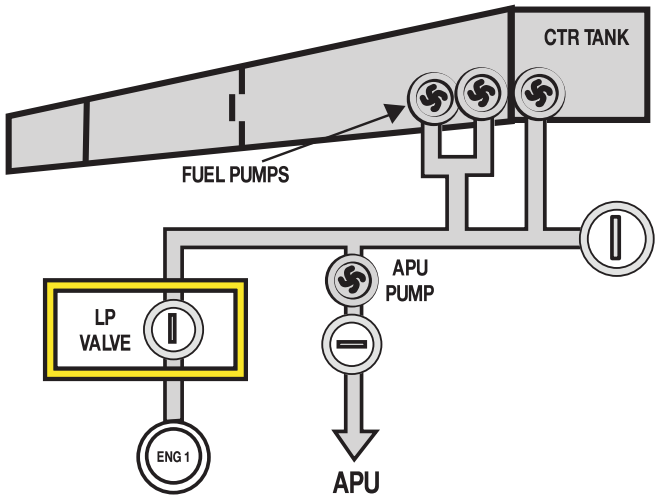
Pressure Reducing Valves

Pressure reducing valves are installed on the wing tank fuel pumps. They allow the center tank fuel to feed preferentially by reducing the output pressure of the wing tank fuel pumps.

Fuel Valves (Continued)

Low Pressure (LP) Engine Fuel Valves

The engine LP fuel valves shut off the supply of fuel to the engines. They are located in each engine fuel feed line at the top of the engine pylons.



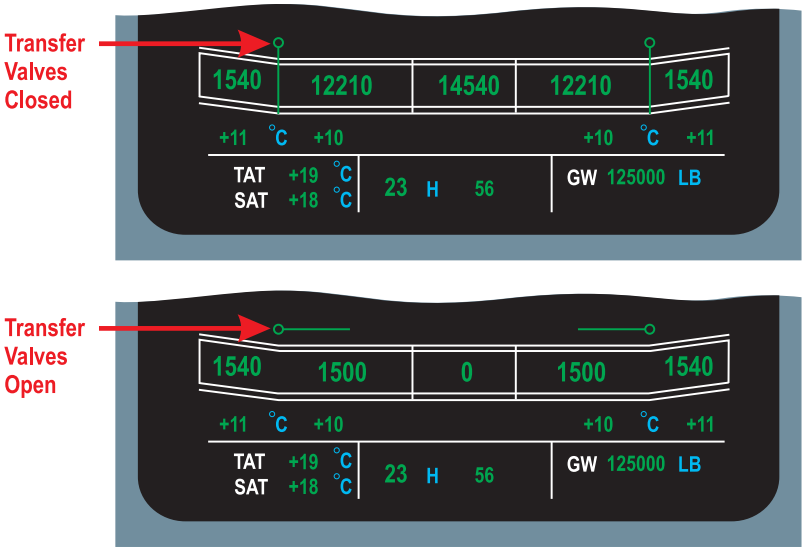
FG28055C

Transfer Valves

The transfer valves are located within the sealed rib which separates the inner from the outer cells of each wing tank. Both transfer valves are automatically commanded open when either inner cell quantity reaches approximately 1650 lbs, this normally equates to approximately 6400 lbs total fuel on board (FOB). These valves are also capable of opening during abnormally high negative wing load conditions.

Each transfer valve's position is displayed on the ECAM Fuel system page. In addition, when the valves are in the open position, the message OUTR TK XFRD appears on the E/WD memo section.

Once opened, transfer valves will not close until refueling.



F280032C

Fuel Quantity Indications

Purpose

The purpose of the Fuel Quantity Indication (FQI) system is to measure the fuel quantity and temperature. This information is displayed on the Engine/Warning Display (E/WD) and ECAM FUEL system display page.

FQI

The FQI system consists of:

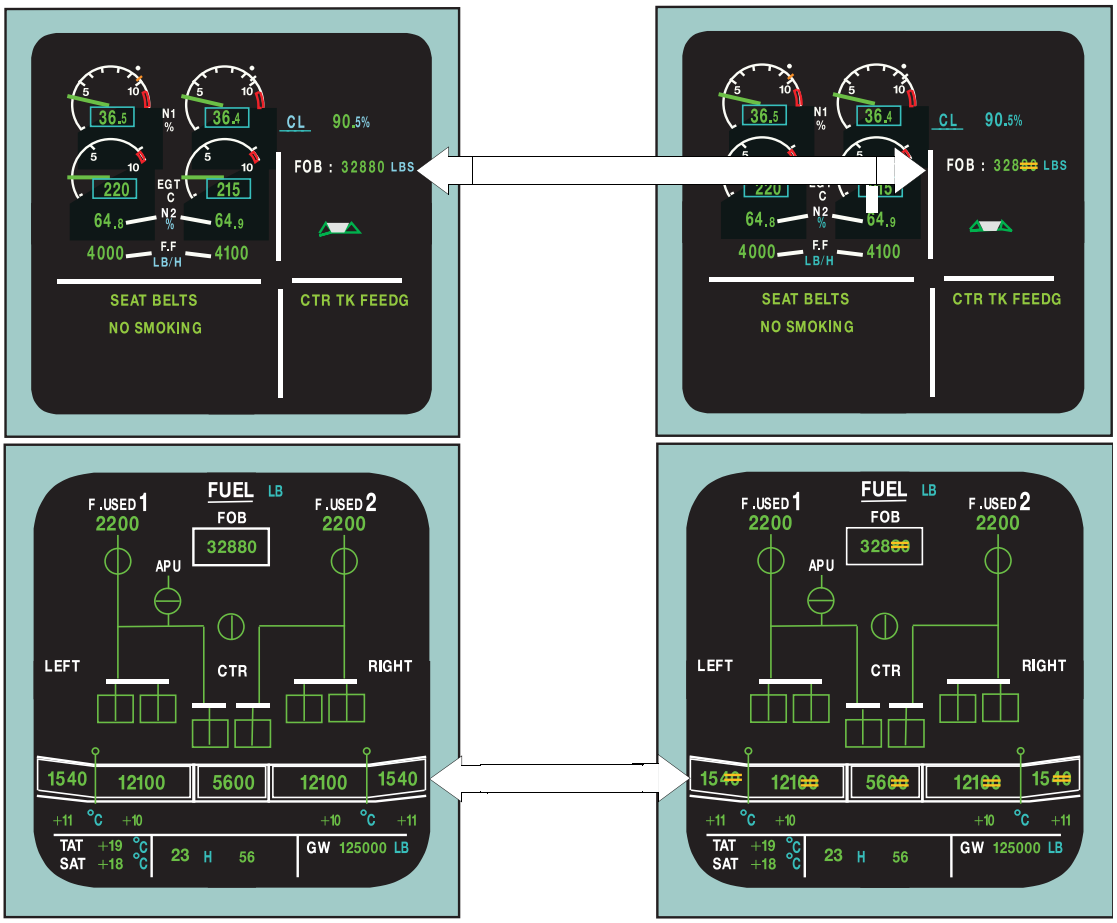
- a dual channel fuel quantity indication computer,
- measuring devices to determine fuel quantity and temperature, and
- the fuel quantity and temperature indicators on the E/WD, ECAM FUEL system display page, and the refueling control panel.

If one channel of the FQI fails, the system will operate in a degraded mode. This mode is indicated by double hash marks across the last two digits of the fuel quantity on both the E/WD and ECAM FUEL system display page.

Fuel Quantity Indications (Continued)

Fuel Quantity Indications

This is an E/WD FOB and ECAM FUEL system display page indication.



Normal Fuel Indications
FG28020C

Degraded Fuel Indications
FG28021C

Magnetic Level Indicators

The fuel quantity can be manually checked using the magnetic level indicators. They are located on the underside of the wing surfaces. There are five indicators in each wing tank: four in the inner cell and one in the outer cell. There is one indicator in the center tank.

Refueling/Defueling

General

The A319/320 can be refueled automatically or manually. The overwing ports allow for gravity refueling and a fuel coupling allows for pressure refueling.

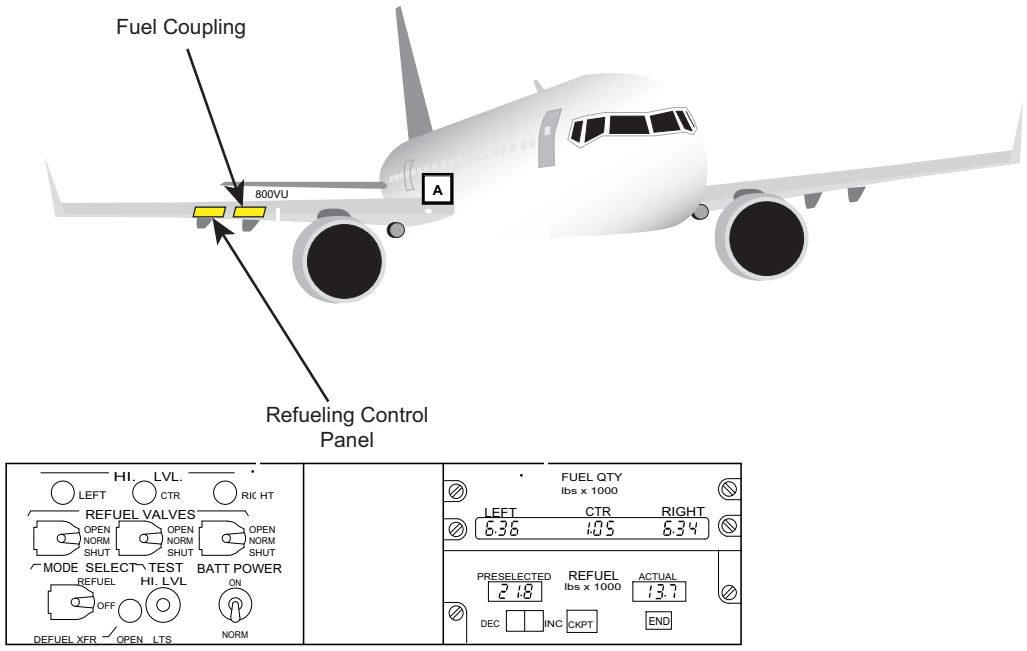
From the refueling control panel, refueling, defueling, and ground fuel transfer between tanks is possible. There is no provision for fuel dumping in flight.

Refueling

Pressure refueling is normally automatic and can be accomplished using battery power only. The single port refueling connection is located under the right wing. The refueling control panel is located next to the fuel coupling on most aircraft and on the right side of the fuselage on some aircraft. During automatic refueling, all fuel tanks (as appropriate) receive fuel simultaneously.

Control Panel

This diagram shows the fuel coupling and refueling control panel.



Fuel quantities on this panel are displayed in pounds.

Manual Refueling

To manually refuel, the refueling valves in each tank are manually controlled from the refueling panel.

The wing tanks must be filled before the center tank is filled.

Gravity Fueling

The A319/320 can be gravity fueled from overwing fuel caps on the wing tanks only. The center tank can be fueled via a ground transfer process.

Controls and Indicators

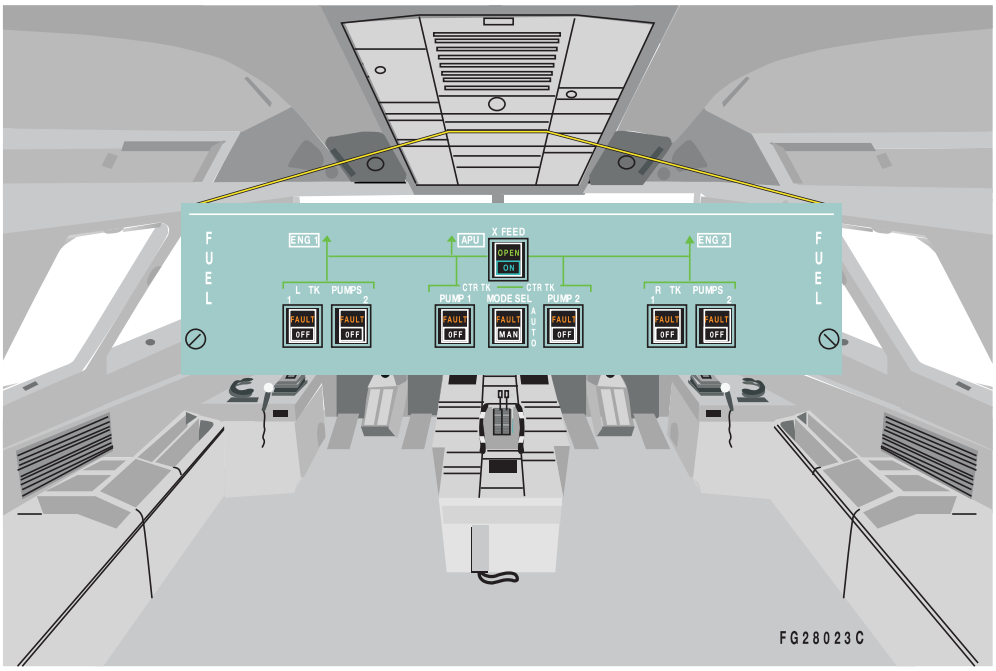
Location of Controls and Indicators

Introduction

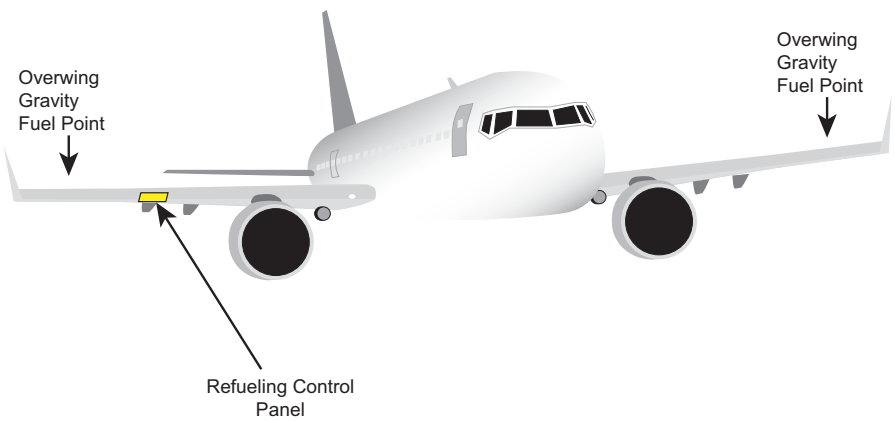
Controls associated with the fuel system are located on the overhead panel and outside the aircraft on the refueling control panel.

Location

The fuel system controls and indicators located in the flight deck are shown below.



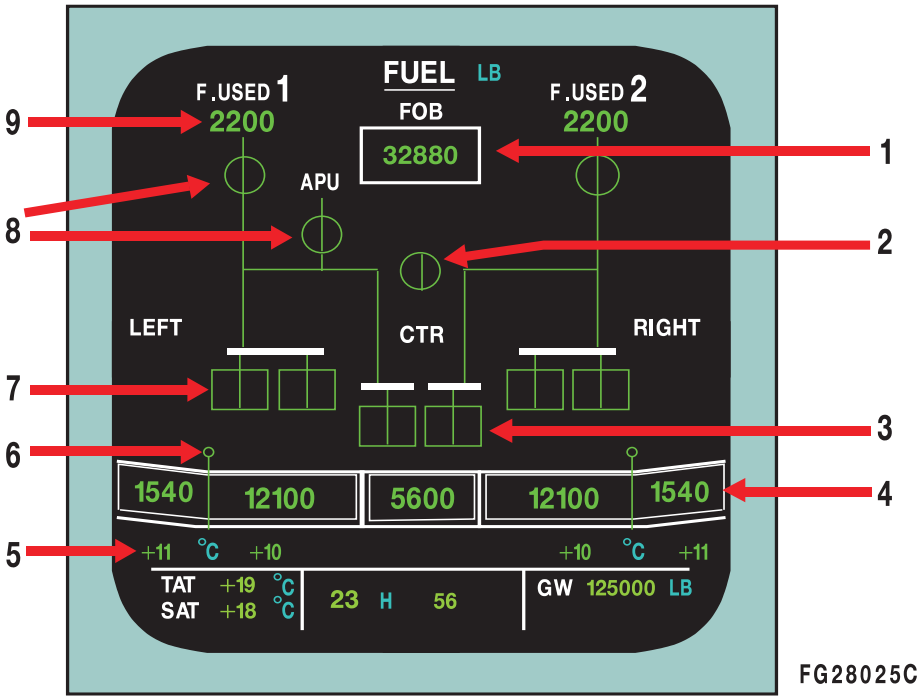
The fuel system controls and indicators located on the refueling control panel are shown below.



ECAM FUEL Page Indications

ECAM FUEL System Display Page

The ECAM FUEL system display page is shown below.



Indications

The indications included on the ECAM FUEL system display page are:

1. Fuel on board (FOB)
2. Crossfeed valve indications
3. Center tank fuel pump indications
4. Fuel quantity indications
5. Fuel temperature indications
6. Transfer valve indications
7. Wing tank fuel pump indications
8. Engine and APU LP valve indications
9. Fuel used indications

Each indication is described in detail on the following pages.

ECAM FUEL System Display Page Indications (Continued)

1. FOB

The total fuel on board, in pounds, is indicated here.

The FOB indication becomes boxed in amber if both center tank pumps have failed, center tank pumps are selected off, or either transfer valve has failed when the inner cell of a wing tank is below the low level sensor.

2. Crossfeed Valve

This valve indicates the position and condition of the crossfeed valve.

Condition	Indication
A green horizontal line indicates that the crossfeed valve is open.	
An amber horizontal line indicates that the crossfeed valve is open when the crossfeed pb is selected off.	
A green vertical line indicates that the crossfeed valve is closed.	
An amber vertical line indicates that the crossfeed valve is closed when the crossfeed pb is selected “ON.”	
An amber diagonal line indicates that the crossfeed valve is in transit.	

3. Center Tank Fuel Pumps

This symbol indicates the position and condition of the center tank pumps.

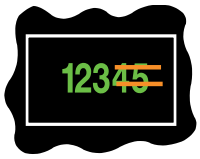
Condition	Indication
A green vertical line indicates that the fuel pump is on and pump pressure is normal.	
An amber “LO” message indicates that the fuel pump is on but the pump pressure is low.	
A green horizontal line indicates that the fuel pump is off in accordance with automatic logic.	
An amber horizontal line indicates that the fuel pump is selected “OFF” in the manual mode of operation.	

ECAM FUEL System Display Page Indications (Continued)

4. Fuel Quantity

Digital fuel quantities in each tank, in pounds, are displayed here. The quantities are provided by the Fuel Quantity Indication Computer (FQIC).

The quantities normally display in green. If FQIC data is degraded, amber lines appear across the last two digits.



FG28032C

An amber box appears around outer cell fuel quantity indications if outer cell fuel fails to transfer when the inner cell fuel reaches the low level sensor, indicating fuel is trapped in the outer cell.

FG28033C

An amber box appears around the center tank quantity if both center tank pumps experience low pressure.

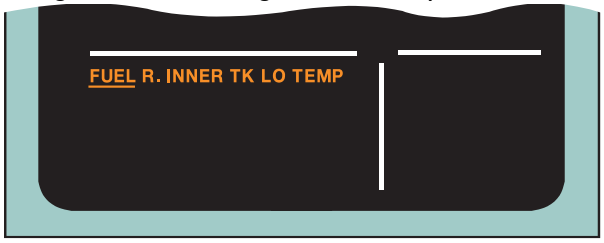
FG28034C

5. Fuel Temperature

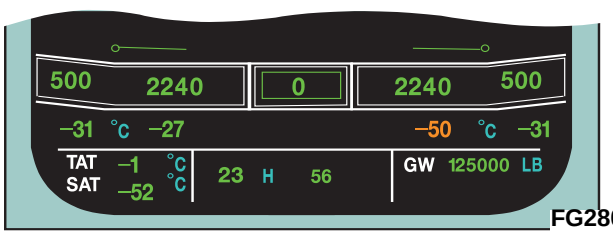
The fuel temperature, in Celsius, for each wing tank is indicated here. The temperatures are provided by sensors located in each tank.

The indications are normally green. The indications pulse in green and then change to amber and an ECAM caution is generated if a high or low temperature limit is exceeded.

E/WD



ECAM FUEL System Display Page

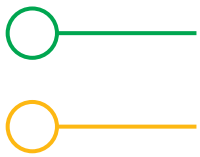
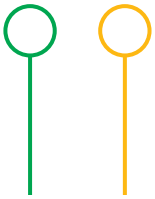


FG28035C

ECAM FUEL System Display Page Indications (Continued)

6. Transfer Valve

This symbol indicates the position and condition of the transfer valves.

Condition	Indication
The transfer valves are open. The symbol is green if fuel in corresponding inner cell is below the low level sensor. The symbol is amber if inner cell is not below the low level sensor.	
The transfer valves are in transit. The symbol is amber when the valve is in transit.	
The transfer valves are closed. The symbol is green if the inner cell has not reached the low level sensor. The symbol is amber if the inner cell has reached the low level sensor and the valve is closed.	

01/01 F280054C

7. Wing Tank Fuel Pumps

This symbol indicates the position of the wing tank fuel pumps.

Condition	Indication
A green vertical line indicates that the fuel pump is on and the pump pressure is normal.	
An amber “LO” message indicates that the fuel pump is on but the pump pressure is low.	
An amber horizontal line indicates that the fuel pump is off.	

ECAM FUEL System Display Page Indications (continued)

8. Engine and APU LP Valves

This symbol indicates the position of the engine and APU LP valves.

Condition	Indication
A green vertical line indicates that the valve is open.	
An amber vertical line indicates that the valve is open when the respective MASTER switch is selected “OFF” or the fire pb is released out.	
APU Only: Green horizontal line indicates that the LP valve is closed.	
APU: Amber horizontal line indicates that the LP valve is closed when the APU MASTER SW pb is selected ON. ENGINE: Indicates the engine MASTER switch is off.	
An amber diagonal line indicates that the valve is in transit.	

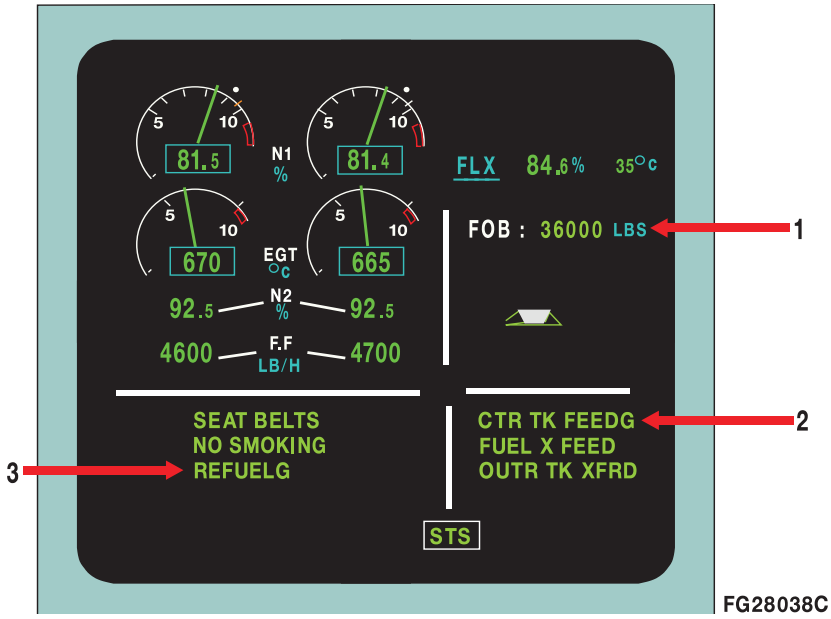
9. F. USED

Indicates the amount of fuel used by each associated engine. The value is automatically reset to zero during engine start.

The engine identification number, 1 or 2, normally appears in white, but turns amber if the respective engine is shut down.

E/WD Fuel Indications

E/WD

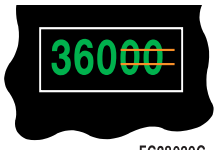


1. Fuel On Board (FOB)

The total fuel on board (FOB), in pounds, is indicated in this location. The fuel indication is normally shown in green.

An amber box appears around the FOB when the fuel quantity is partially trapped (e.g., transfer valve failure). The last two digits of the fuel indication become dashes if the FQI data is degraded.

Fuel Trapped



FG28039C

Fuel Quantity Indications Degraded

2. Right Memo Section

Memos concerning fuel operations appear in green in this area.

CTR TK FEEDG - The center fuel tank is the current source of fuel supply to the engines.
FUEL X FEED - The FUEL X FEED pb has been selected “ON.”
OUTR TK XFRD - The transfer valves have opened.

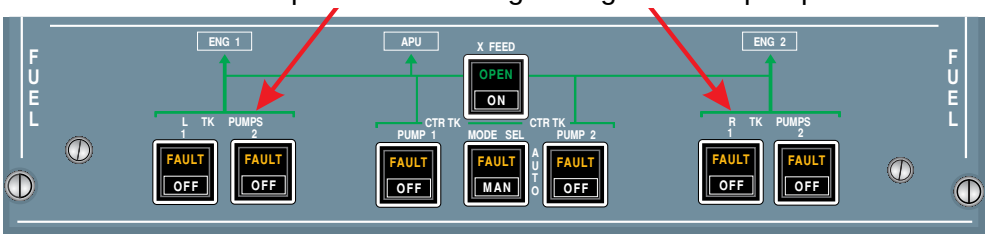
3. Left Memo Section

REFUELG - The refueling control panel door is open.

Wing Tank Fuel Pump pbs

Function

The L TK PUMP 1 & 2 pbs control the left wing tank fuel pumps.
The R TK PUMP 1 & 2 pbs control the right wing tank fuel pumps.

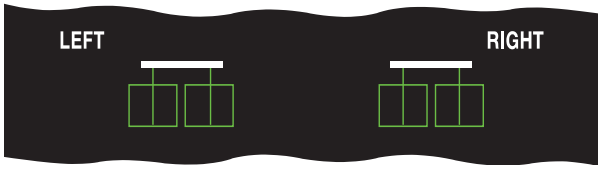


01/01 F280056C

On

When selected on (lights out), the pump is energized. Fuel is fed only when the corresponding center tank fuel pump is not operating and when the center tank is empty.

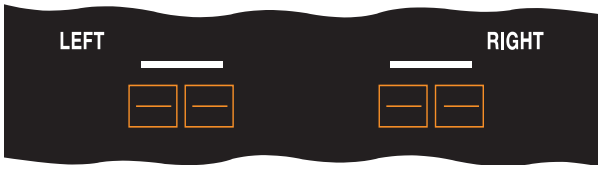
The resulting ECAM indication is a green box with a vertical line when operation is normal.



OFF

The deselected (out) position deactivates the pump.

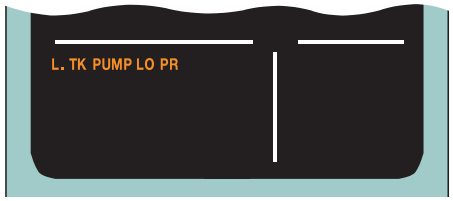
When selected off, the “OFF” light is illuminated on the pb. The resulting ECAM indication is an amber box with a horizontal line.



FAULT

The FAULT light illuminates when the delivery pressure drops below a predetermined level. This light is inhibited when the pump is in the OFF position.

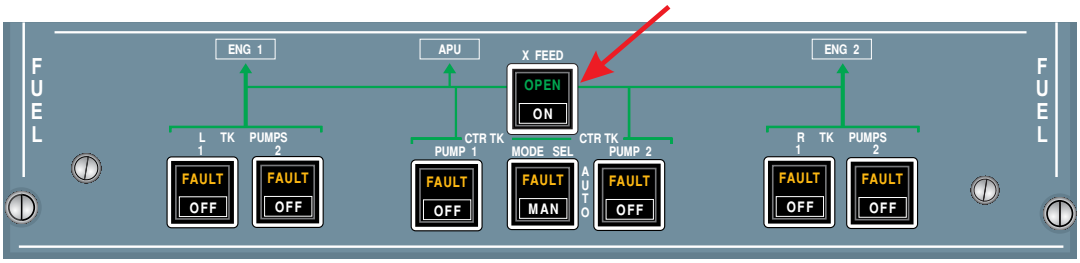
When a fault condition occurs, the FAULT light is illuminated on the pb. The resulting ECAM indication is an amber box with LO in the center of it, and a caution message.



X FEED pb

Function

The X FEED pb allows for the operation of the crossfeed valve.



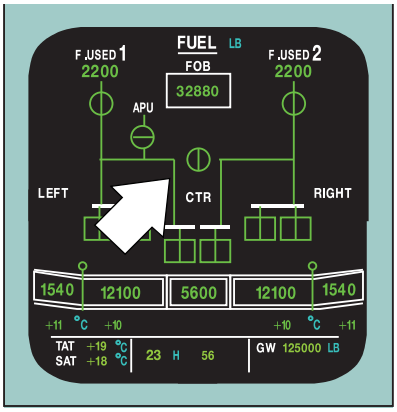
01/01 F280043C

Closed

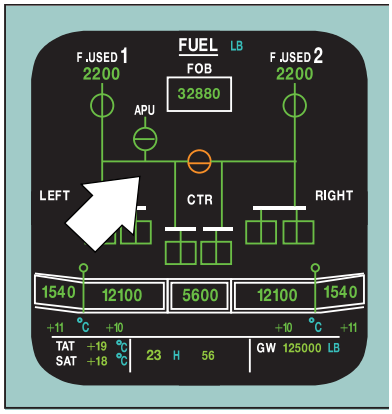
In the closed (extended out) position, the crossfeed valve closes.

When the pb is selected closed (lights out), the pb is in the released (out) position. The resulting ECAM indication for the valve is a green circle with a vertical line.

If the valve doesn't close, and the pb is off, the resulting ECAM indication is an amber circle with a horizontal line.



Crossfeed Closed



Crossfeed Open (disagreement)

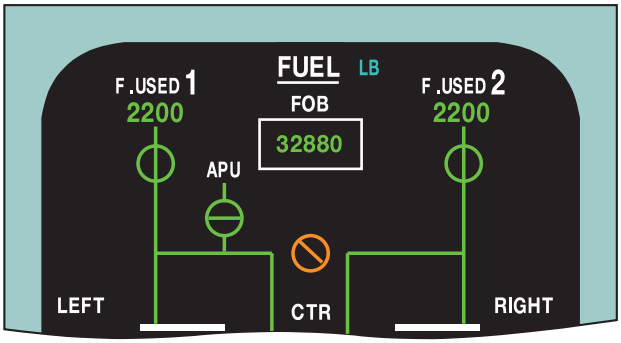
FG28045C

X FEED pb (continued)

ON

In the ON (pressed in) position, the crossfeed valve opens.

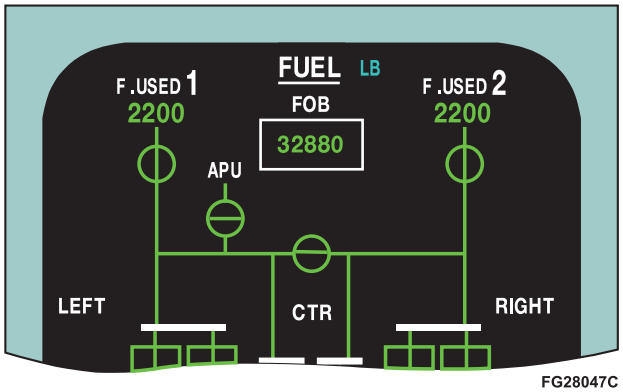
When the pb is selected on, the ON light illuminates white on the pb. The ECAM indication below shows the valve in transit.



FG28046C

OPEN

When the pb is selected on, the ON light illuminates white. When the valve has fully opened, OPEN illuminates green. The resulting ECAM indication for the valve fully open is a green circle with a horizontal line.



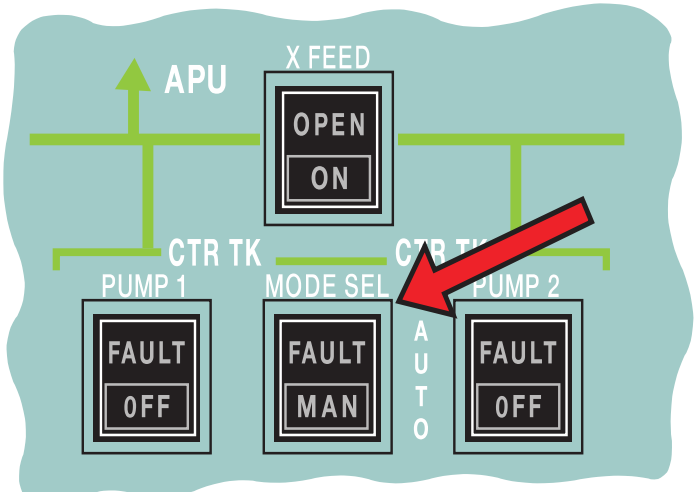
FG28047C

In the event of a valve failure, the ECAM indication for the valve closed (with the pb ON) is an amber circle with a vertical line. In this case the “OPEN” light would not be illuminated.

MODE SEL pb

Function

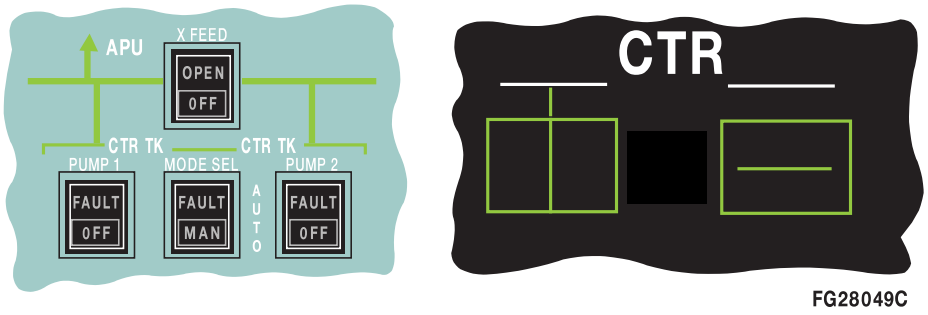
The center tank mode selector is a latching pb which controls the selection of automatic or manual operation of the center tank fuel pumps.



AUTO

When the MODE SEL pb is in AUTO (lights out) and the center tank pump pbs are selected on, the center tank pump operation is automatic.

AUTO Position (lights out)



FG28049C

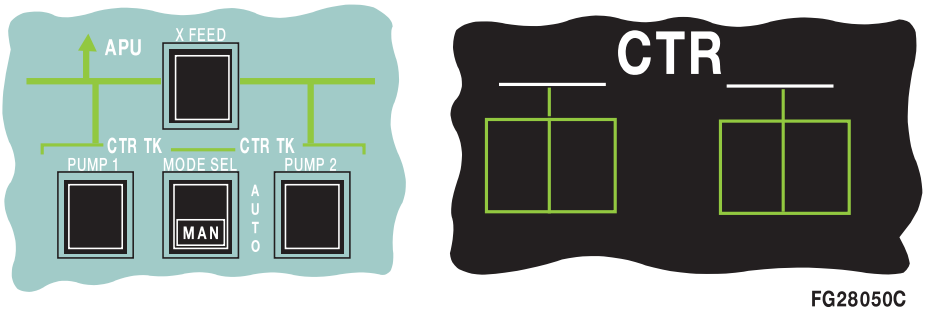
MODE SEL pb (continued)

MAN

In the MAN position, the center tank fuel pumps are controlled by the position of the CTR TK PUMP 1 (2) pbs, and MAN illuminates in the pb.

Mode Selector: Manual

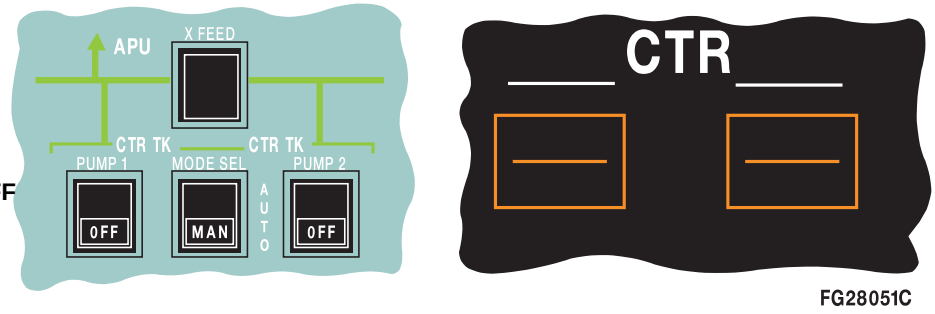
CTR TK FUEL PUMPS: ON



FG28050C

Mode Selector: Manual

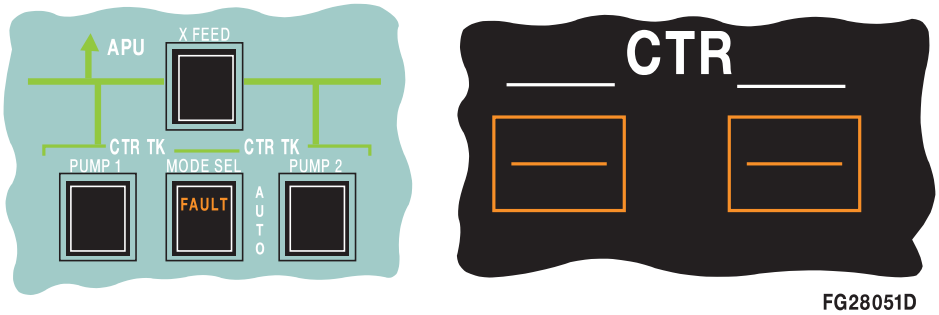
CTR TK FUEL PUMPS: OFF



FG28051C

FAULT

FAULT illuminates in the MODE SEL pb when wing tank fuel is being used with a significant amount of fuel still in the center tank or when the aircraft is improperly fueled.



FG28051D

Note: A FAULT light may illuminate during refueling if there is fuel in the center tank before the wing tanks are full.

Refueling Control Panel

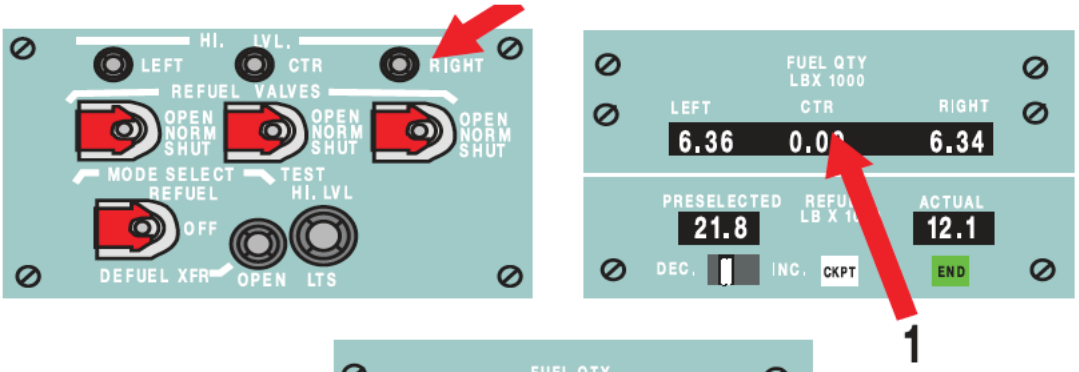
Purpose

The refueling control panel allows for control of the refueling, defueling, and ground fuel transfer. The controls and indicators on this panel and their use are described in Vol. 1, SP.12.

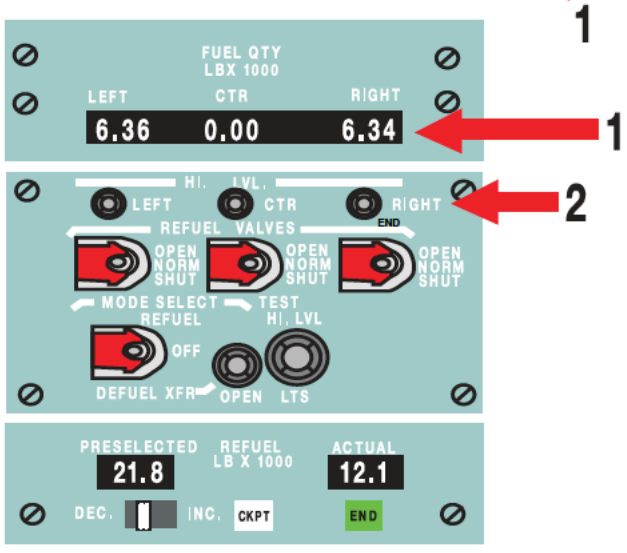
Except for fuel quantity and the REFUELG message on the E/WD, there are no repeat indications of the refueling control panel in the cockpit.

This is a diagram of the refueling control panel.

Wing Mounted Configuration



Fuselage Mounted Configuration



FG28052C

1. FUEL QTY

The fuel quantity in each tank is displayed in thousands of pounds.

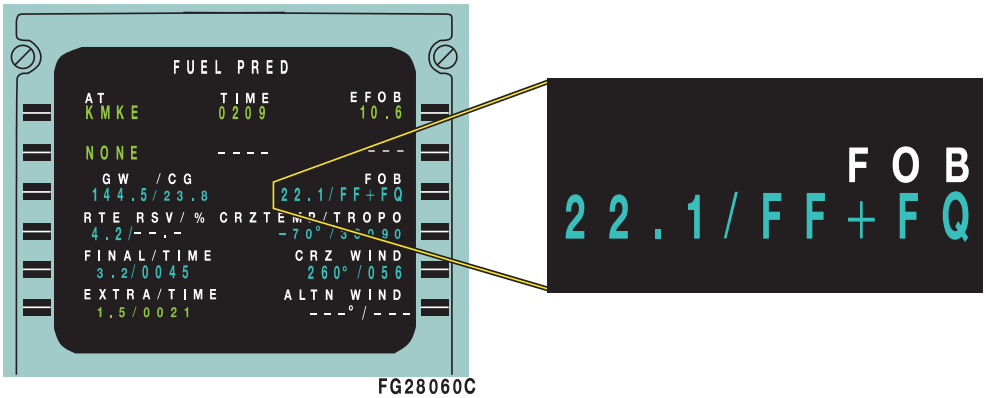
2. HI LVL

These lights illuminate blue when a high level of fuel is detected in the tank.

FMGC Fuel Indications

General

The two Flight Management and Guidance Computers (FMGCs) display the computed on board fuel quantity on the Multifunction Control and Display Unit (MCDU) fuel prediction (FUEL PRED) page.



FG28060C

The fuel quantity displayed on this page is computed using a combination of the initial fuel quantity entered in the MCDU during preflight, the fuel quantity measured by the fuel quantity (FQ) sensors, and the amount of fuel used, as measured by the fuel flow (FF) sensors. This computed fuel provides a secondary indication of Fuel On Board (FOB), and can be used to monitor fuel quantity with an inoperative fuel tank sensor.

The FMGC adds the computed fuel quantity to the aircraft's zero fuel weight (entered in the MCDU during preflight), allowing the aircraft's gross weight (GW) to be computed and displayed on this page. This MCDU page is discussed in detail in chapter 34, Navigation.

Chapter 29: Hydraulics

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System Description

General Description

Introduction

The hydraulic system is made up of three separate and independent systems: Green, Blue, and Yellow. Each is supplied by its own hydraulic reservoir. Each system provides pressure to operate many major components, such as flight controls, slats and flaps, landing gear, cargo doors, and the emergency generator.

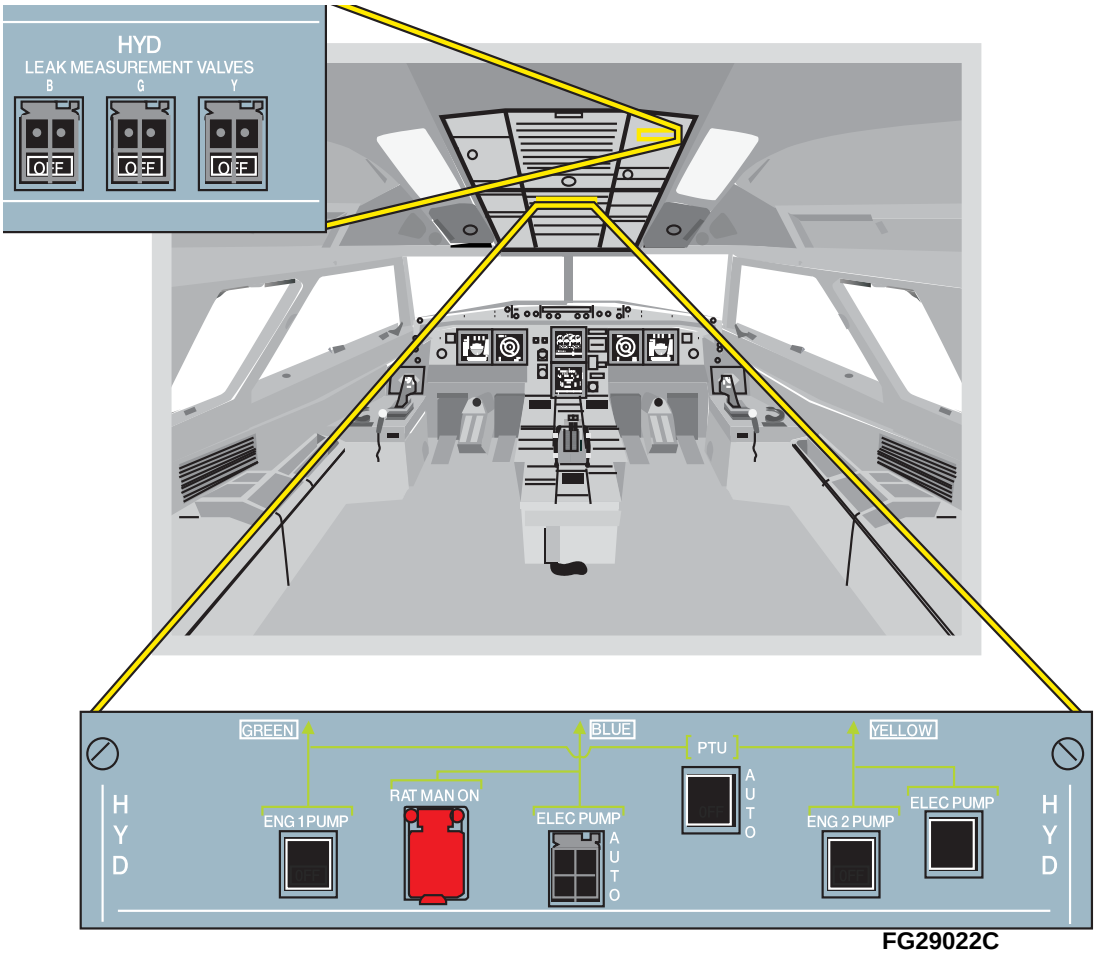
The main panel for the hydraulics system is located in the middle of the overhead panel. The hydraulics panel has controls for the Green, Blue, and Yellow systems.

Additional controls are found on the Maintenance panel, used primarily by maintenance personnel.

The ECAM HYD page displays the status of the various hydraulic components.

Location

The hydraulic system controls and indicators located in the flight deck are shown below:



FG29022C

General Description (continued)

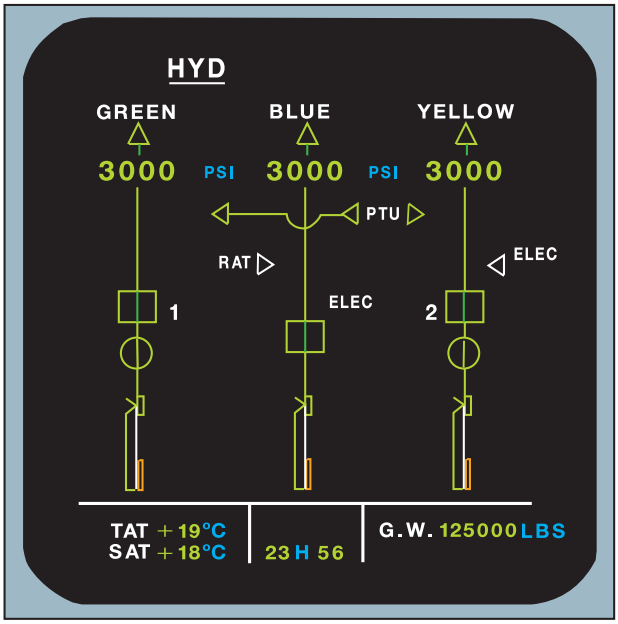
System Breakdown

Each system has its own pump (or pumps), reservoir, accumulator, and except for the Blue system, a fire valve.

Each hydraulic system generates power separately and delivers that power to the user components. Interchange of hydraulic fluid from one system to another cannot occur.

There are separate controls for the Green, Blue, and Yellow systems on the overhead panel. These controls are used during abnormal situations.

All three systems are represented on the ECAM HYD page.



FG29004C

Green Hydraulic System

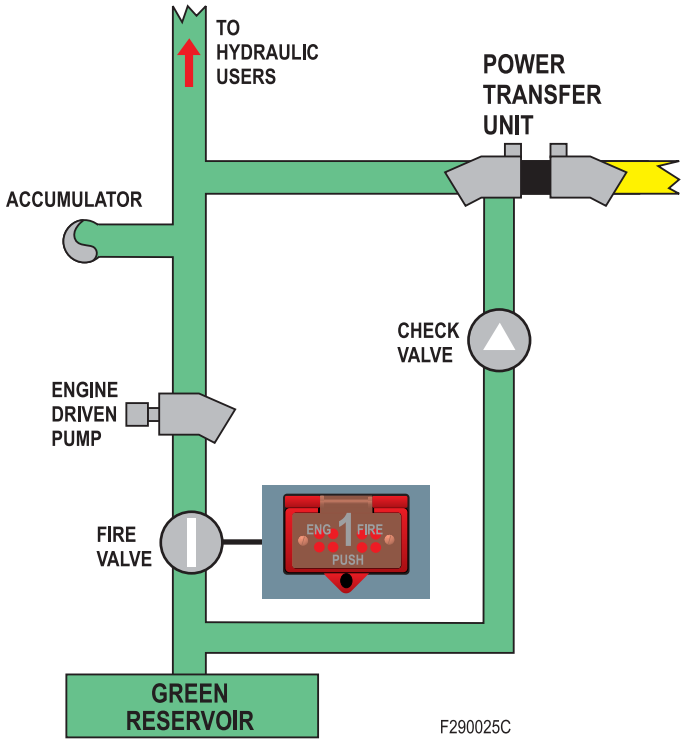
General

The Green hydraulic system provides exclusive pressure to some components while sharing pressure to others. The STATUS page can be used to identify inoperative components due to the loss of the Green hydraulic system.

The Green hydraulic system is pressurized by one of two sources:

- the ENG 1 PUMP or
- the PTU.

The following diagram illustrates the Green hydraulic system.



Note: Closure of the Fire Valve does not prevent fluid flow from the reservoir to the Power Transfer Unit (PTU).

Normal Operation

In the Green system, the hydraulic fluid flows from the reservoir, through the Fire Valve, to the engine pump.

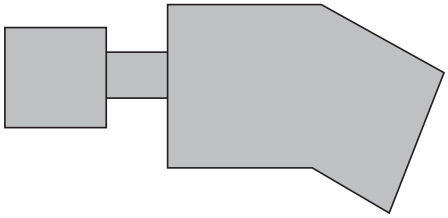
From the pump, pressurized hydraulic fluid flows to the accumulator. The accumulator operates when the pump is not able to supply enough pressure to meet transient system demands.

From the accumulator, pressurized fluid flows to various users of system pressure. It then returns to the reservoir.

Green Hydraulic System (continued)

ENG 1 Pump

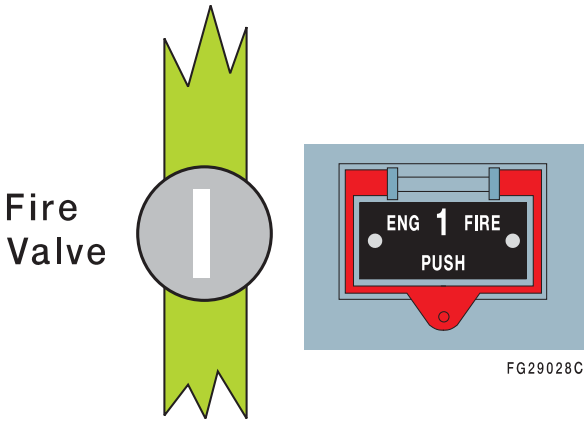
The left ENG 1 pump normally pressurizes the Green hydraulic system. During normal operation the pump automatically operates when engine 1 is rotating.



FG29024C

FIRE pb

If the ENG 1 FIRE pb is pushed and released, the Green hydraulic system Fire Valve closes. With the Fire Valve closed, fluid flow from the reservoir to the engine pump is blocked.



FG29028C

Yellow Hydraulic System

General

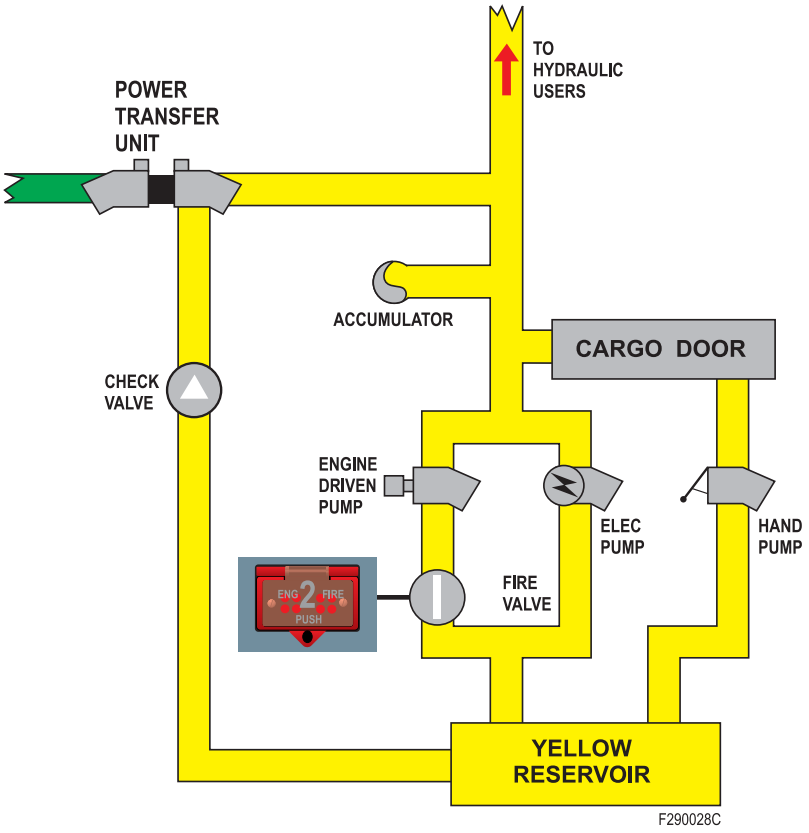
The Yellow hydraulic system provides exclusive pressure to some components while sharing pressure to others. The STATUS page can be used to identify inoperative components due to the loss of the Yellow hydraulic system.

The Yellow hydraulic system can be pressurized by one of four sources:

- the ENG 2 PUMP,
- the PTU, or
- the Yellow ELEC PUMP.

A hand pump, which can provide limited system pressure for cargo door operation when the engines are not running and there is no external or APU power available.

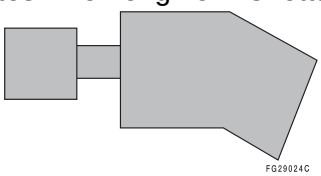
The following diagram illustrates the Yellow hydraulic system.



Note: Closure of the Fire Valve will not prevent fluid flow from the reservior to the Power Transfer Unit (PTU).

ENG 2 Pump

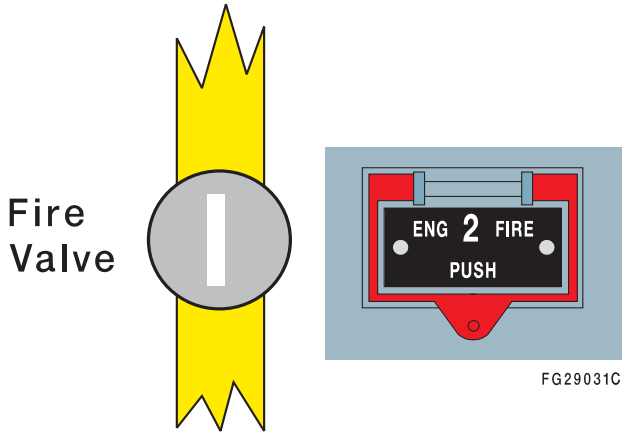
The ENG 2 pump normally pressurizes the Yellow hydraulic system. During normal operation the pump automatically operates when engine 2 is rotating.



Yellow Hydraulic System (Continued)

Eng 2 FIRE pb

If the ENG 2 FIRE pb is pushed and released, the Yellow system hydraulic Fire Valve closes. With the Fire Valve closed, fluid flow from the reservoir to the engine pump is blocked.



Yellow ELEC PUMP

An electrically powered pump, commonly referred to as the Yellow Electric Pump, is installed to provide an alternate source of hydraulic pressure when no other power source is available to the yellow hydraulic system.

The pump can be controlled from either the ELEC PUMP pb on the hydraulic control panel on the flightdeck, or from either cargo door control levers located adjacent to each respective cargo door. Yellow system capability differs depending on which control is used to activate the pump.

When utilizing the ELEC PUMP pb to activate the pump, the pump is allowed to pressurize the entire yellow system. When selected on, the word ON (blue) appears on the pb. The ECAM hydraulic system page will display a normally functioning yellow system. When selected off the pb is lights out.

Placing a cargo door selector in either the OPEN or CLOSE position will activate the pump. However, the yellow system in this case will only power; the cargo doors, the alternate brake system and the reverser blocker doors for engine 2.

Note: There are no direct flight deck indications as to pump operation when a control lever is used to activate the pump. The ECAM hydraulic system page will indicate the pressure output of the electric pump.

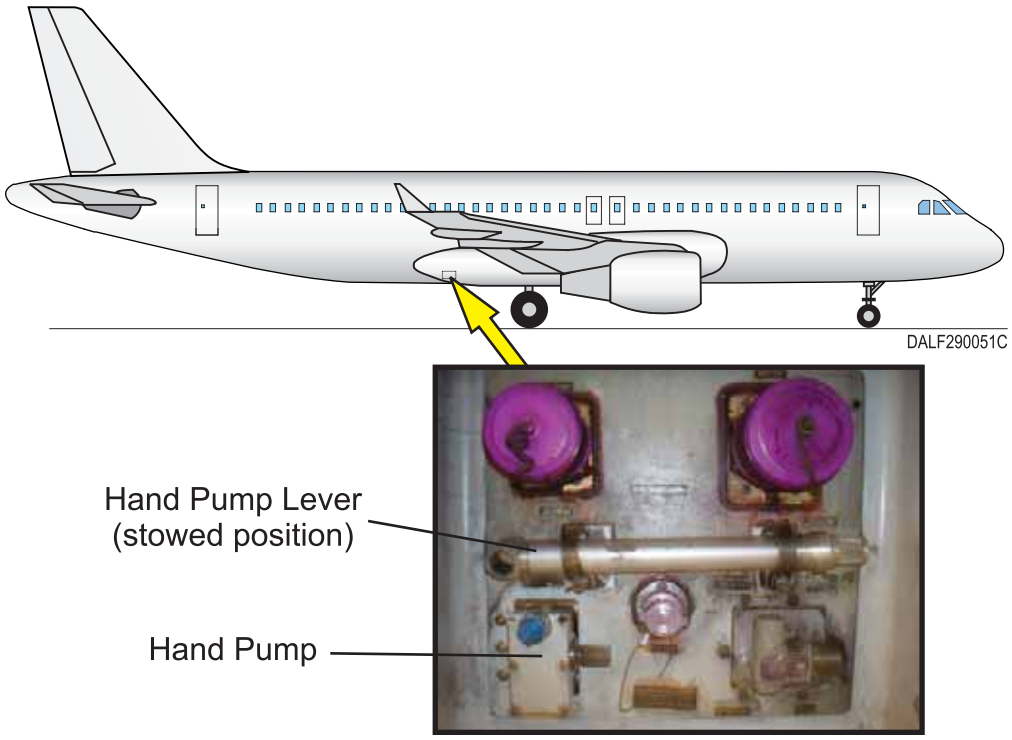
Yellow Hydraulic System (continued)

Yellow System Hand Pump

The Yellow Hydraulic system is equipped with a manually operated hand pump which on the ground, can be used to pressurize the yellow system when no other power source is available.

The hand pump would typically be used to open and close the aircraft's cargo doors when no electrical power is available to operate the yellow system electric pump.

The hand pump is accessed through the Yellow System Hydraulic Ground Service panel located on the aft portion of the right main landing gear faring.

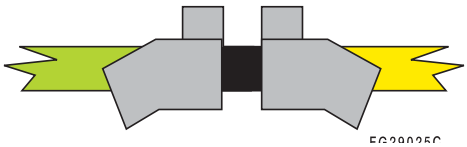


Note: An identical Hydraulic Ground Service panel is located on the aft portion of the left main landing gear faring. This panel is associated with the Green Hydraulic system.

Power Transfer Unit (PTU)

Power Transfer Unit (PTU)

The Power Transfer Unit, commonly referred to as the PTU, is a bidirectional hydraulic motor/pump which provides an alternate power source to the Green and Yellow hydraulic systems without transferring fluid from one system to the other.



The PTU monitors the differential pressure between the Green and Yellow systems. Should the differential pressure exceed a 500 psi, the system with the higher pressure would power the PTU's motor which would in-turn operate the PTU's pump. The PTU's pump would pressurize the hydraulic fluid of the system with the lower pressure for continued normal operation. The PTU's pump output pressure is capable of meeting all of the respective system's operating requirements.

PTU Automatic Operation

The PTU operates in an automatic mode when its control pb, located on the HYD portion of the overhead control panel, is lights out. In the automatic mode, the PTU is armed for operation. When activated, HYD PTU (Green) appears on the memo section of the E/WD.

On the ground, the PTU performs a momentary self-test when the second engine is started. Following the self-test, the PTU returns to an armed mode.

When enabled in the automatic mode, the PTU's operation is inhibited when:

- the Yellow system's electric pump is activated by either cargo door lever
- the engine master switches are in opposing (one engine running) positions and either condition exists:
  - nose wheel steering is disconnected by the towing lever on the nose gear
  - the parking brake is on

When selected off the word OFF appears on the pb. When selected off, the PTU is incapable of automatic reactivation (see section 29.20 for additional PTU indications on the HYD systems page).

PTU Fault

A PTU malfunction is represented by the word FAULT (Amber) on the PTU pb, however this indication is not associated with a direct internal malfunction of the PTU but rather as a result of a malfunction of either the Green or Yellow hydraulic systems. The word FAULT appears when:

- Green or Yellow system failure is due to loss of fluid
- Green or Yellow system reservoir has overheated
- Green or Yellow system reservoir air pressure is low

Note: Following a successful self-test, should the PTU incur an internal malfunction, there will be no ECAM indication to alert the crew. In addition, the HYD systems page will continue to display the PTU in an armed mode (Green). In the event of a failed engine driven pump and a failed PTU, the ECAM and the HYD systems page would only indicate and display the failure of the respective hydraulic system.

Blue Hydraulic System

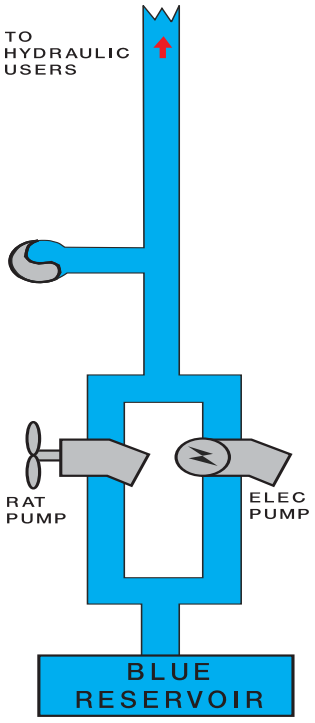
General

The Blue hydraulic system shares pressure to components with other hydraulic systems and provides exclusive pressure to a constant speed, motor generator during electrical emergencies. The STATUS page can be used to identify inoperative components due to the loss of the Blue hydraulic system.

The Blue hydraulic system is pressurized by one of two pressure sources:

- the Blue electric pump or
- the Ram Air Turbine (RAT)

The following diagram illustrates the Blue hydraulic system.



FG29032C

Normal Operation

In the Blue system, the hydraulic fluid flows from the reservoir to the Blue electric pump. The pressurized fluid then flows to the accumulator, to the hydraulic components, then returns to the reservoir.

If the RAT is extended, hydraulic fluid flows through the RAT.

Blue ELEC PUMP

An electric motor driven pump normally powers the Blue hydraulic system.

On the ground, during normal operations, the pump is automatically powered when:

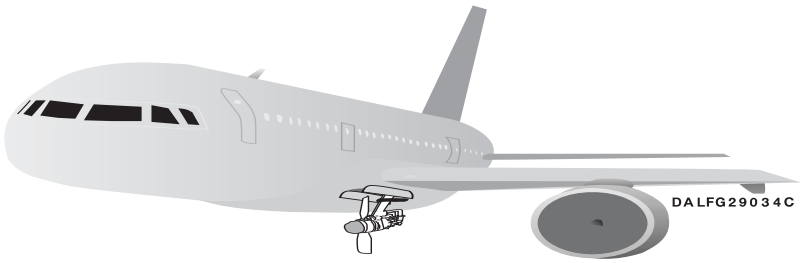
- either engine is running, and
- AC BUS 1 is powered.

In flight, the pump operates when the electrical system is in a normal configuration.

Blue Hydraulic System (continued)

RAT

The Ram Air Turbine (RAT) is provided for emergency use. It is a small propeller-driven hydraulic pump located in the lower fuselage near the left wing root. This pump provides backup pressure supply to the Blue hydraulic system at a nominal pressure, provided there is sufficient airflow through the RAT propeller.



The RAT can be deployed:

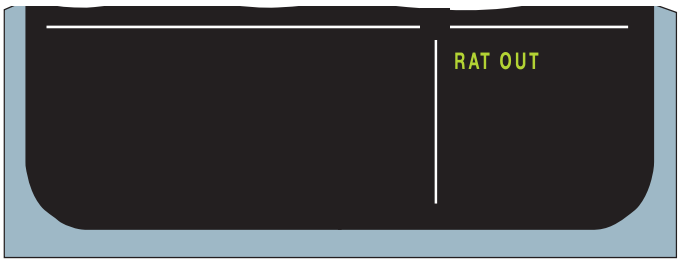
- Manually - by pressing the RAT MAN ON pb on the HYD overhead panel.
- Manually - by pressing the EMER ELEC ON pb on the overhead panel. However, this method also connects the emergency generator to the essential AC and DC buses and is not recommended for hydraulic system abnormals.
- Automatically - in flight only, whenever AC Bus 1 and 2 are depowered

Warning

Activation of the MAN ON pb even with no power on the aircraft will cause immediate deployment of the RAT and could cause injury or death

Once the RAT is deployed, it can only be stowed by maintenance when the airplane is on the ground.

RAT deployment is indicated on the ECAM E/WD as RAT OUT in the memo section.



Blue Hydraulic System (continued)

Abnormal Operation

Three conditions will cause the Blue system to be degraded:

- a failure in the Blue electric pump,
- a reservoir failure, or
- a RAT failure after a Blue electric pump failure.

A Blue reservoir failure requires the shut down of the Blue hydraulic system.

When the electric pump is shut off, the only backup pump available to pressurize the Blue system is the RAT. Failure of the Blue system electric pump does not automatically deploy the RAT.

The RAT allows the Blue system to be pressurized in the event of electrical power loss or dual engine failure. In the case of a Blue reservoir abnormal, it is not advisable to continue to pressurize the system. The ECAM procedure will direct the shut down of the Blue system electric pump and a FAULT light will illuminate on the BLUE ELEC PUMP pb.

If the Blue system has been shut down due to a reservoir overheat, the system may be selected back on when the overheat condition no longer exists.

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Controls and Indicators

Location of Controls and Indicators

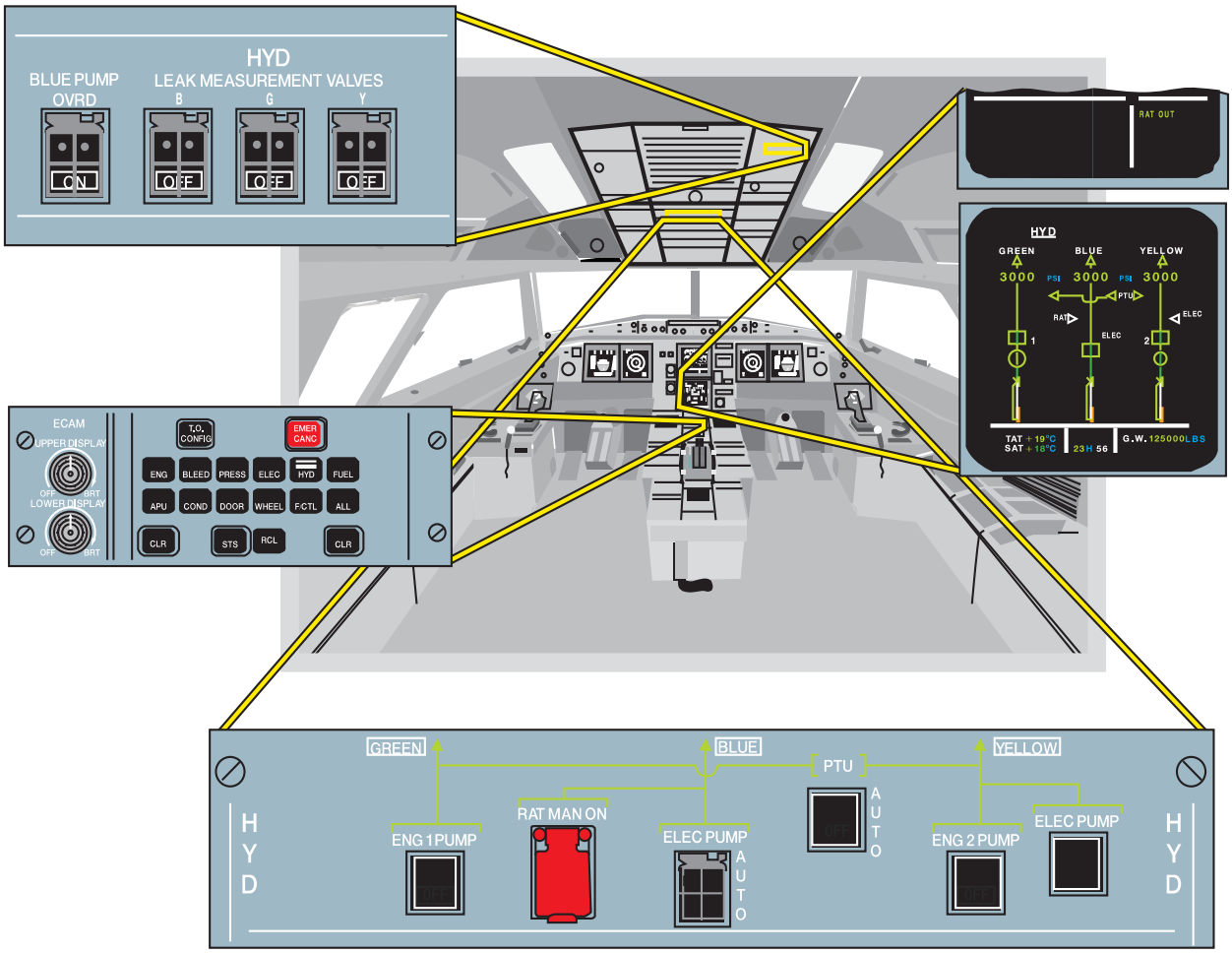
Introduction

Controls associated with the hydraulic system are located on the overhead panel and Maintenance panel.

Indications for the hydraulic system are located on the ECAM E/WD and ECAM HYD page.

Location

The hydraulic system controls and indicators are illustrated below.



FG29036C

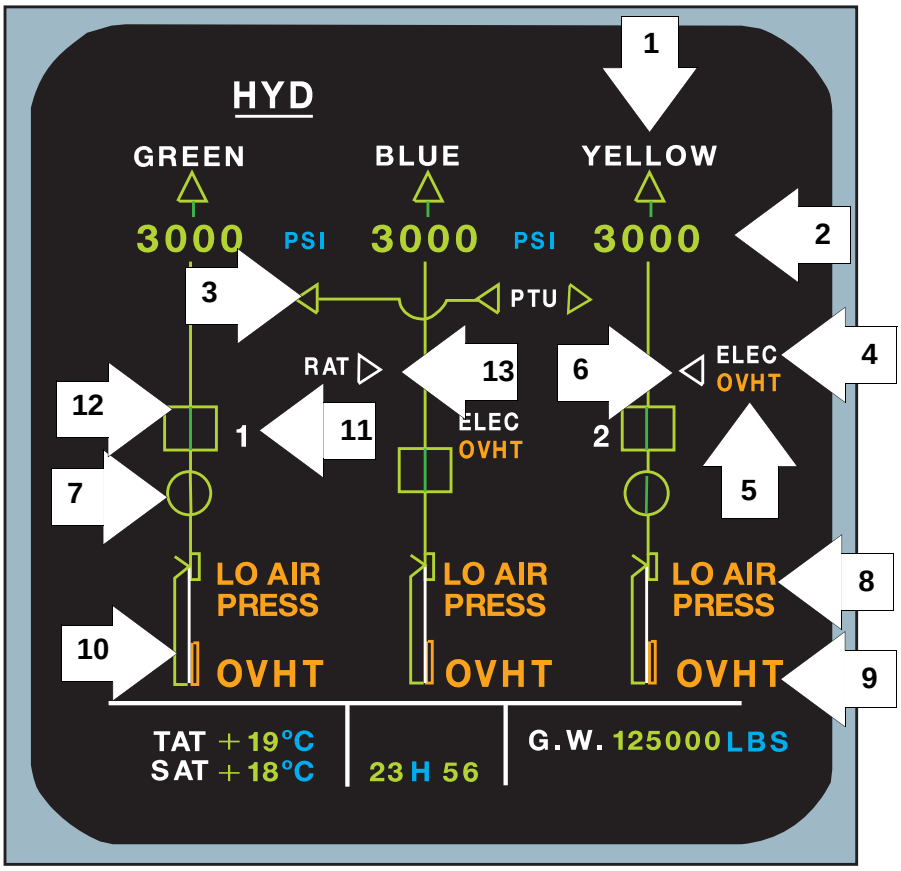
ECAM HYD Page

General

The ECAM HYD page shows the status of each of the hydraulic systems. The hydraulic reservoir status, hydraulic pump status, system pressure, and Fire Valve positions are shown, as well as all warnings.

Diagram

This is the ECAM HYD page.



FG29038C

ECAM HYD Page (continued)

1. System Label

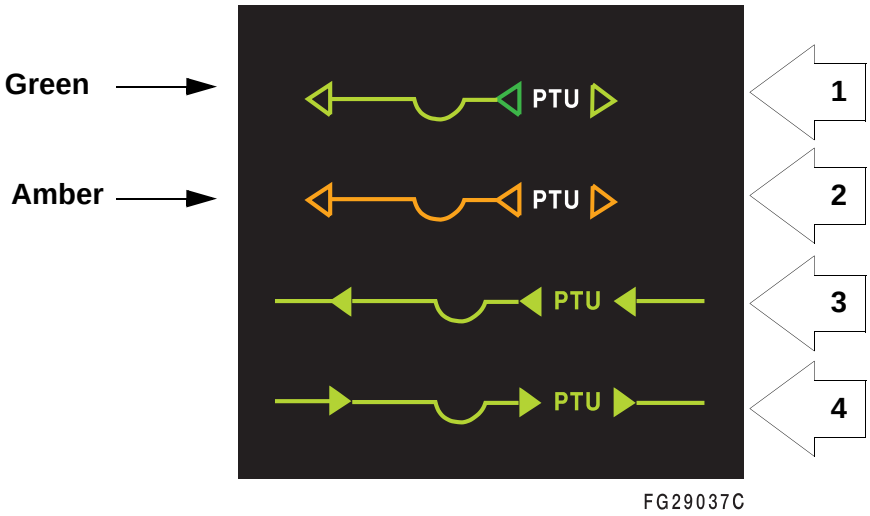
The label of each hydraulic system is normally white. The triangle symbol below is green if the pressure is normal and turns amber if the pressure drops below normal.

2. System Pressure Indication

The system pressure indication is normally green, but becomes amber when the system pressure is less than normal.

3. PTU

The Power Transfer Unit (PTU) indication is located between the Green and Yellow systems.



1. Green arrows pointing away from “PTU” in white indicates that the PTU pb is in the AUTO position and the PTU is armed, but not yet supplying pressure to either system. (Normal indication with both engine pumps operating and the PTU not inhibited.)
2. An amber indication means: the PTU has been selected OFF or the PTU is inhibited.
3. This indication means that the PTU is supplying pressure to the Green system.
4. This indication means that the PTU is supplying pressure to the Yellow system.

4. ELEC Indication

This indication is normally white. It changes to amber if the power supply fails.

5. OVHT Indication

This indication appears in amber if the electric pump overheats.

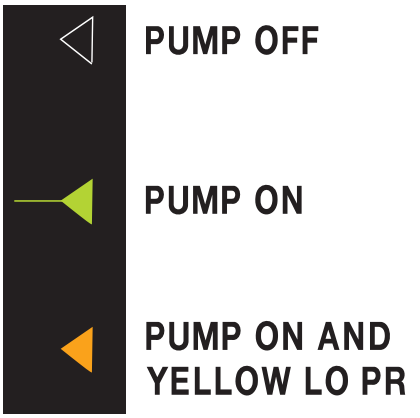
ECAM HYD Page (continued)

6. Yellow Electric Pump Triangle

When the pump is OFF, an open white triangle appears.

If the pump is ON, and Yellow system pressure is normal, a green triangle with a leader line appears.

If the pump is ON, and the Yellow system pressure is low, an amber triangle appears.



7. Fire Valve Indication

A green circle with a vertical line indicates that the fire valve is not fully closed.

An amber circle with a horizontal line indicates that the fire valve is fully closed.

8. Reservoir LO AIR PRESS Indication

The reservoir is normally pressurized to prevent pump cavitation. The message LO AIR PRESS appears in amber, accompanied by an ECAM caution message, when the reservoir pressure drops below normal.

9. Reservoir OVHT Indication

The reservoir OVHT indication appears in amber, accompanied by an ECAM caution message, if the return hydraulic fluid temperature is above normal.

10. Reservoir Quantity Indication

Reservoir quantity is indicated as a vertical line with a caret on it, indicating the fluid level. The indication is considered to be normal when the point is within the adjacent green box. These indications become amber and accompanied by an ECAM caution message when the fluid level is below a preset limit.

11. Engine Numbers

The numbers by the engine driven pumps are normally displayed in white. They are amber when the engine is not running.

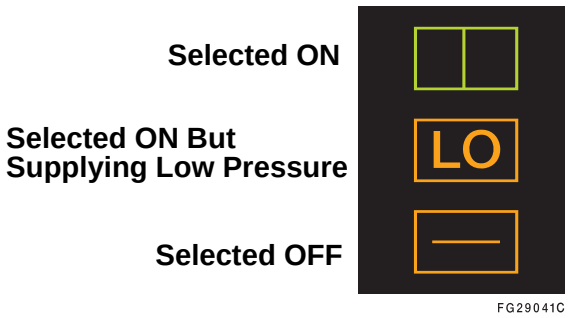
ECAM HYD Page (continued)

12. Engine Driven Pumps

The Green and Yellow systems' engine driven pumps are displayed as a green box with a vertical line when the ENG 1 (2) PUMP pb is selected on and hydraulic pressure is normal.

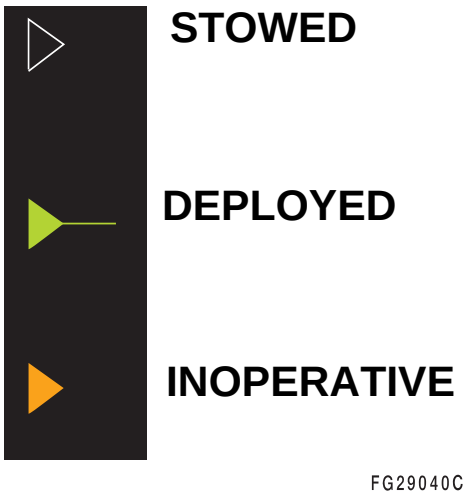
An amber LO indication means that the ENG 1 (2) PUMP pb is selected on and the hydraulic pressure is low.

An amber box with a horizontal line indicates that the ENG 1 (2) PUMP pb is selected to OFF.



13. RAT Status Indication

- when the RAT is stowed, an open white triangle indication appears,
- if the RAT is deployed, and operating normally, a green triangle with a leader line appears, or
- if the RAT hydraulic pump is inoperative, an amber triangle appears.



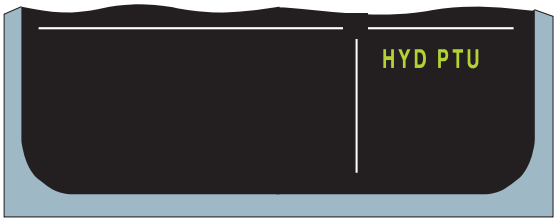
E/WD Hydraulic System Memo Messages

Memo Messages

The memos that appear on the right side of the E/WD page for the hydraulic system are HYD PTU and RAT OUT.

HYD PTU

The HYD PTU message appears in green when the PTU is running.

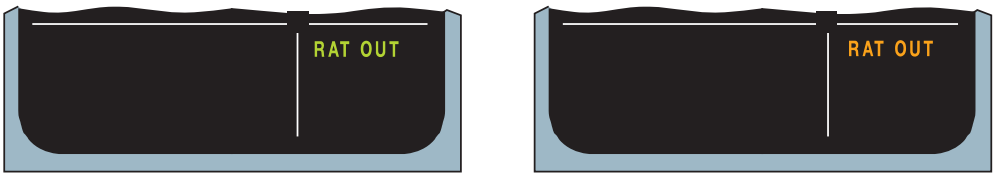


FG29043C

RAT OUT

The RAT OUT message appears in green when the RAT is not fully stowed in flight.

The RAT OUT message appears in amber on the ground prior to takeoff power application if the RAT is not fully stowed.

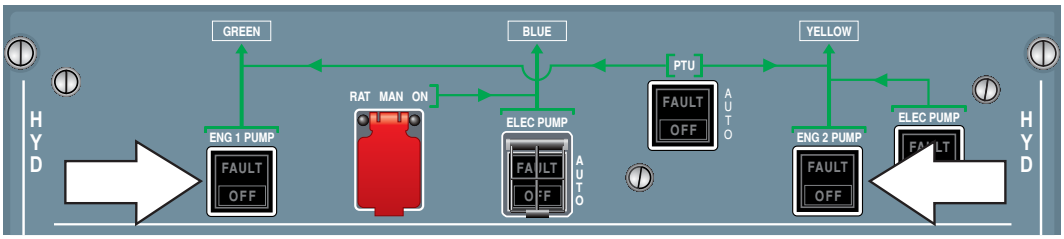


FG29042C

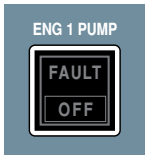
ENG 1 (2) PUMP pbs

Function

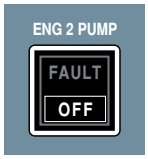
The ENG 1 PUMP pb controls the left ENG 1 hydraulic pump. The ENG 2 PUMP pb controls the right ENG 2 hydraulic pump.



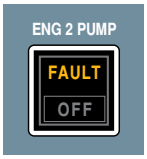
02/01 F290038C



ON-SYSTEM PRESSURIZED



OFF-SYSTEM DEPRESSURIZED



FAULT

ON

When the pushbutton is selected to the ON (lights out) position, the pump will pressurize its respective hydraulic system when the engine is running.

The associated ECAM indication is a green box with a vertical line when the engine is running and the output pressure is normal.

OFF

In this position, the pump is depressurized, and the “OFF” light is illuminated on the pb. The associated ECAM indication is an amber box with a horizontal line.

FAULT

The FAULT light illuminates amber when:

- the reservoir is at a low level,
- the reservoir overheats (“FAULT” remains illuminated as long as the overheat condition exists),
- the pump produces a low output pressure on the ground with engine running or anytime in flight, or
- the reservoir air pressure is low.

Note: The reservoir related FAULT lights illuminate to direct the pilot’s attention to the pb. They **do not** indicate that the pump has malfunctioned.

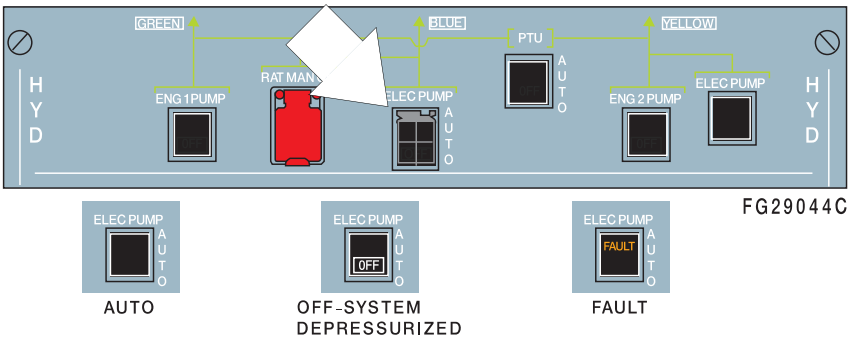
The following ECAM messages are associated with a fault condition.

- RSVR LO LVL
- RSVR OVHT
- RSVR LO AIR PR
- ENG PUMP LO PR

BLUE ELEC PUMP pb

Function

The BLUE ELEC PUMP pb is a guarded pb. It controls the Blue electric pump. It is normally in the AUTO (lights out) position.



AUTO

OFF-SYSTEM DEPRESSURIZED

FAULT

AUTO

The Blue electric pump is always energized in flight if AC power is available.

In this position (lights out), with AC power available, the pump will begin to operate on the ground when at least one engine is running.

The ECAM indication with the pump running is a green box with a vertical line.

OFF

In this position the pump is deenergized, OFF is illuminated and the ECAM indication is an amber box with a horizontal line.

FAULT

FAULT illuminates amber when:

- the reservoir is at a low level,
- the reservoir overheats, (FAULT remains illuminated as long as the overheat condition exists),
- the pump produces a low output pressure on the ground with an engine running or anytime in flight,
- the pump has overheated, or
- the reservoir air pressure is low.

Note: The reservoir related FAULT lights illuminate to direct the pilot's attention to the pb. They **do not** indicate that the pump has malfunctioned.

The following ECAM messages are associated with a fault indication:

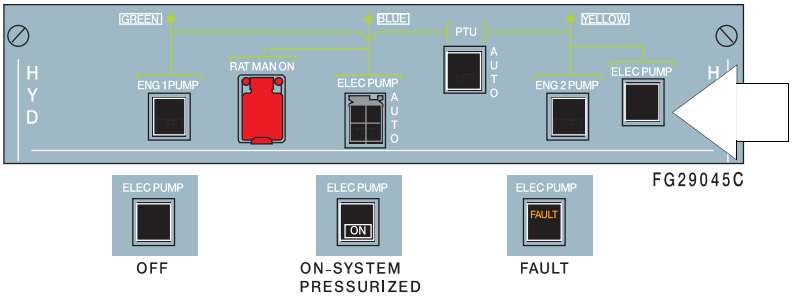
- RSVR LO LVL
- RSVR OVHT
- RSVR LO AIR PR
- ELEC PUMP LO PR
- ELEC PUMP OVHT

YELLOW ELEC PUMP pb

Function

The YELLOW ELEC PUMP pb controls the Yellow electric pump.

It is normally in the off (lights out) position.



OFF | ON-SYSTEM PRESSURIZED | FAULT

OFF

In this position (lights out), the pump is deenergized. This is the normal position.

The pump will automatically energize if the cargo door manual selector valve is moved. The operation of the PTU and flight controls is inhibited while the cargo doors are in operation, and for a short period of time after they cease operation.

In the off position, the pb is blank, and the ECAM indication is a white open triangle.

ON

When the pb is selected ON, the pump is energized and ON illuminates. The pump remains energized until the pb is deselected to off (or until electrical power is removed).

The ECAM indication with the pump running is a green triangle with a leader line.

Caution: *The Yellow electric pump will pressurize the flight controls and flaps through the Yellow and Green hydraulic systems (through the PTU) if energized before start.*

FAULT

With the pump selected on, FAULT illuminates amber whenever the following has occurred:

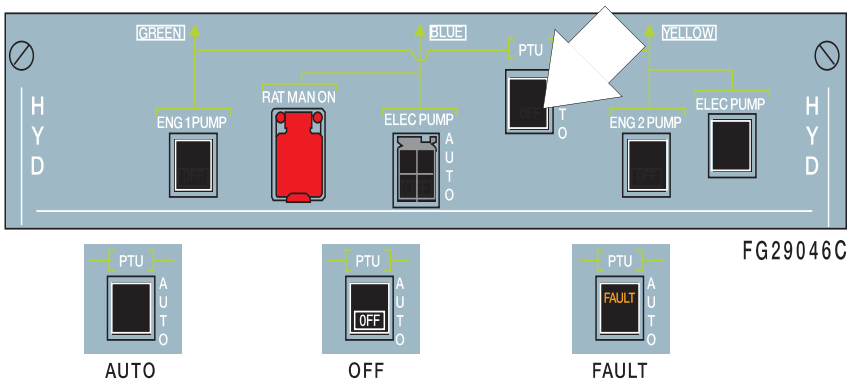
- the pump's output pressure is sensed below operating requirements,
- the reservoir is at a low level,
- reservoir fluid has overheated (FAULT remains illuminated as long as the overheat condition exists),
- reservoir air pressure is sensed to be low, or
- the pump has overheated.

Note: If illumination was a result of a temperature exceedance, the FAULT light will extinguish once the associated temperature has been reduced below the preset limit.

PTU pb

Location

.



AUTO

The PTU is placed in the AUTO mode when the pb is selected lights out. In the AUTO mode the PTU will:

- on the ground, perform a self-test when the second engine is started
- automatically engage when differential pressure between the Green and Yellow hydraulic systems reaches a predetermined value

When enabled in the automatic mode, the PTU's operation is inhibited when:

- the Yellow system's electric pump is activated by either cargo door lever
- engine master switches are in opposite positions and:
  - nose wheel steering is disconnected by the towing lever on the nose gear
  - the parking brake is on

FAULT

The word FAULT appears on the pb when:

- Green or Yellow system failure is due to loss of fluid,
- Green or Yellow system reservoir has overheated (FAULT remains illuminated as long as the overheat condition exists), or
- Green or Yellow system reservoir air pressure is low.

Note: The FAULT indication is only associated with a Green or Yellow system malfunction.

Note: Should the PTU fail **after** the automatic PTU test during engine start, the ECAM will **not** inform the crew. The crew will be aware of the failure only if a subsequent Green or Yellow pump failure occurs. When the crew views the ECAM HYD systems page they will see that the PTU is not providing pressure to the failed side.

OFF

When deselected off, the word OFF appears on the pb. The PTU is incapable of automatic reactivation when selected off.

RAT MAN ON pb

Function

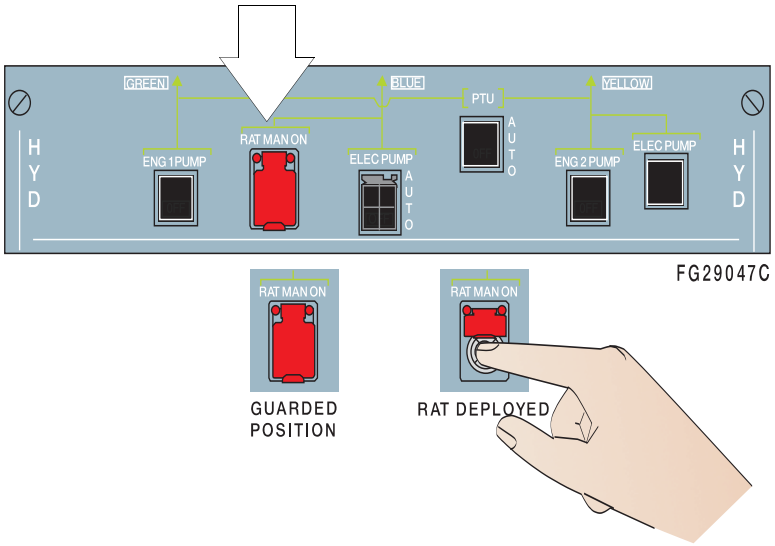
The RAT MAN ON pb, located on the HYD section of the overhead control panel, is used to manually extend the Ram Air Turbine (RAT) to pressurize the Blue hydraulic system. In order to gain access to the PB, its red guard must first be lifted.

When deployed, the message RAT OUT appears in green on the right side of the E/WD memo section. The ECAM Hydraulic System page indication with the RAT extended is a green triangle with a leader line. The ECAM indication of an inoperative RAT is an amber triangle

Warning

Activation of the MAN ON pb even with no power on the aircraft will cause immediate deployment of the RAT and could cause injury or death

.

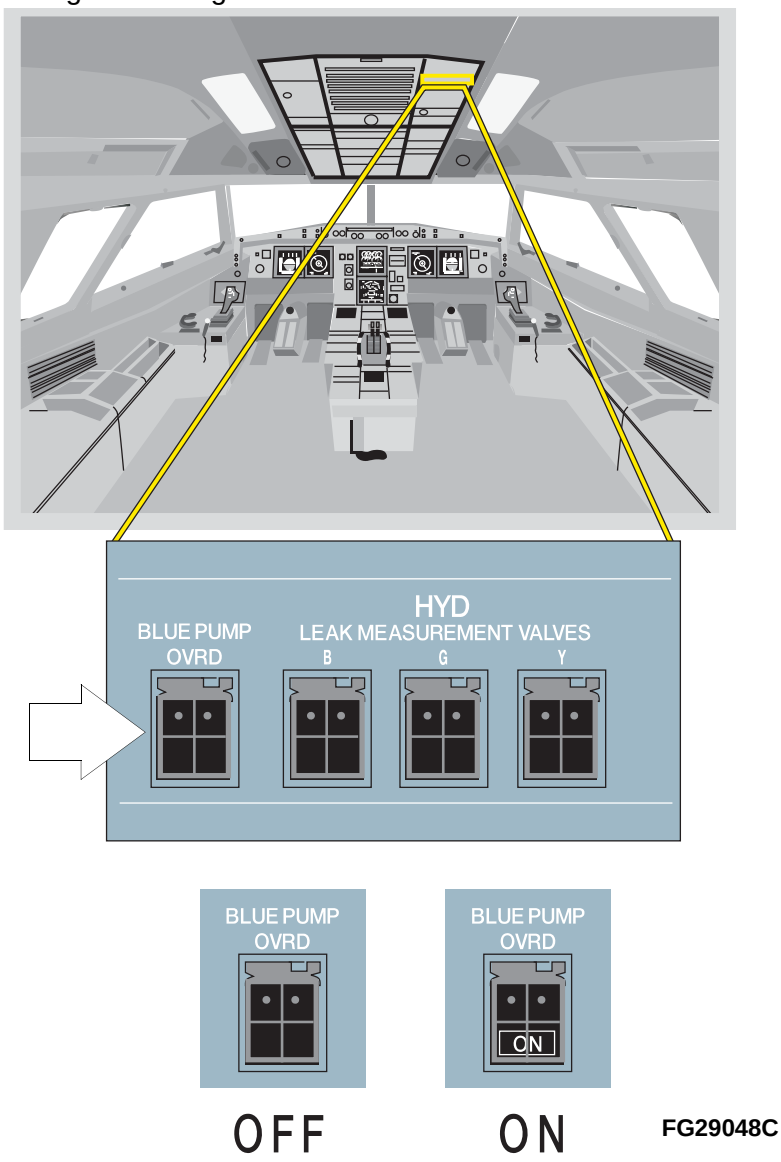


Note: In flight RAT extension occurs automatically with a loss of AC BUS 1 and 2. In this case, the emergency generator is also automatically activated.

BLUE PUMP OVRD pb

Function

The BLUE PUMP OVRD pb allows maintenance personnel to operate the Blue electric pump without an engine running. It is located on the overhead Maintenance panel.



FG29048C

OFF

The Blue electric pump is deenergized until an engine is running or the pb is selected ON. This is the normal position of the pb.

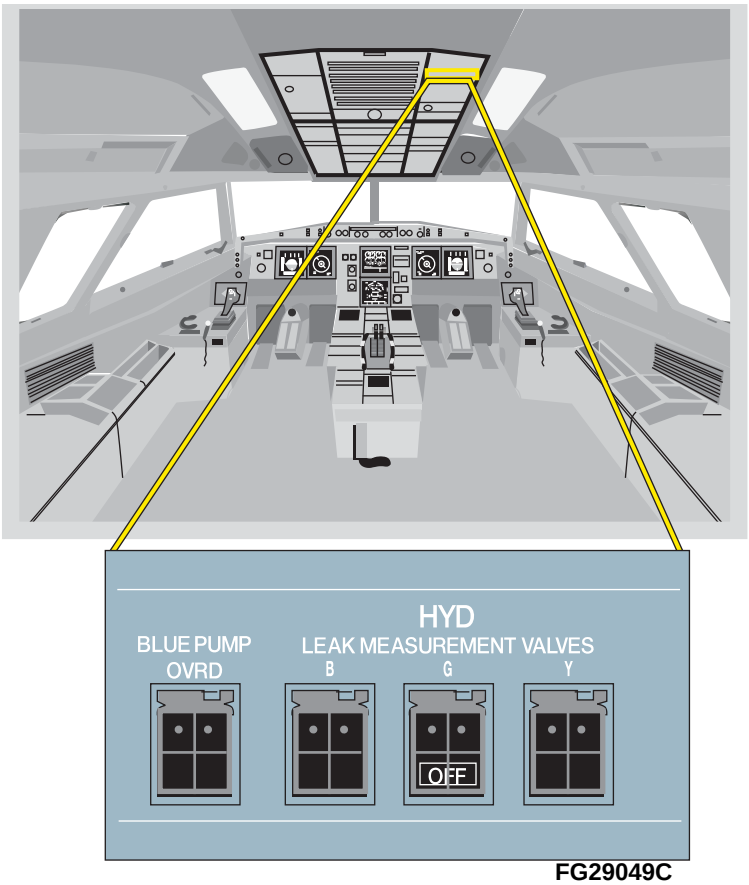
ON

The Blue electric pump is energized. ON illuminates on the pb.

B, G, and Y HYD LEAK MEASUREMENT VALVE pbs

Function

These pbs are used by maintenance personnel to isolate leaks in the hydraulic systems.



FG29049C

ON

The normal position of the pb is on (light out). This allows hydraulic fluid to go to all hydraulic components in the respective systems.

OFF

In this position, the leak measurement valves are closed in the respective systems. Hydraulic fluid is no longer available provided to the flight control actuators. OFF illuminates on the pb.

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Chapter 30: Ice and Rain Protection

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WING ANTI ICE pb 30.20.4
ENG 1 (2) pbs 30.20.6
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Rain Control Panel Controls 30.20.9

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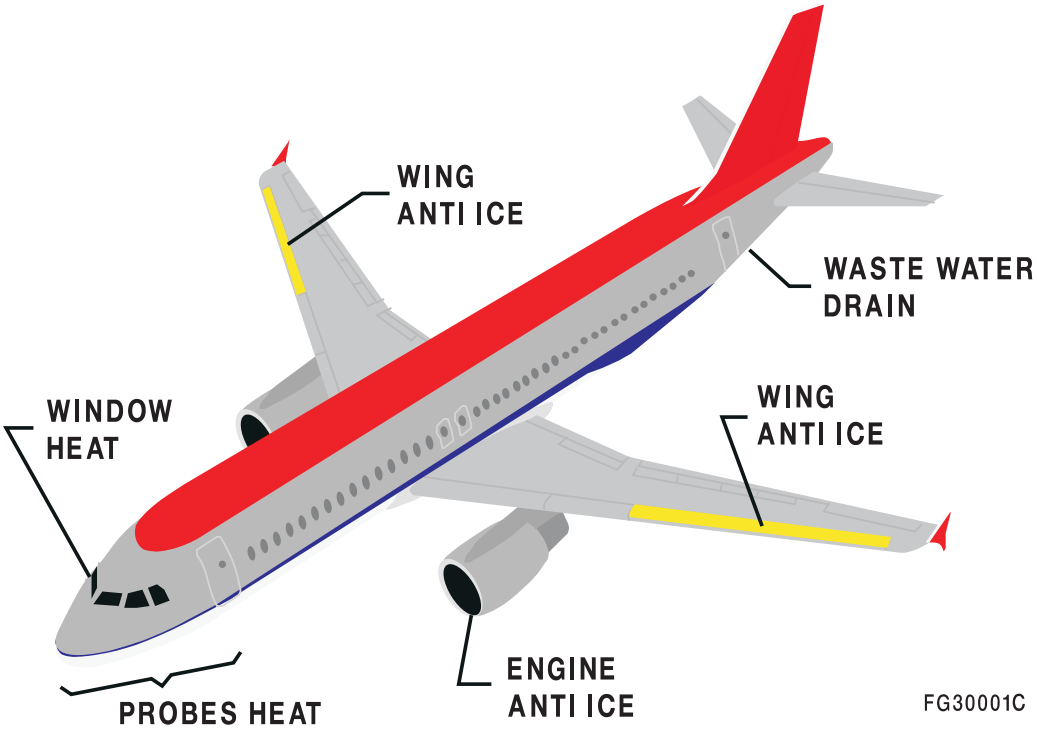
System Description

Location of Ice and Rain Protection System Components

Introduction

There are a number of components associated with the ice and rain protection system. They are located throughout the aircraft as depicted below.



General Description

Purpose

The ice and rain protection system is installed to permit unrestricted operation of the aircraft in icing conditions and heavy rain. Major components served by the anti-ice system are:

- engines,
- wings,
- windows, and
- probes and sensors.

System Description

Icing protection is provided by either hot air from the pneumatic system, or electrical heating. Components served by each include:

- hot air for:
  - outboard leading edge slats of each wing, and
  - engine nacelle leading edges.
- electrical heating for:
  - flight deck windows,
  - probes, pitot tubes, static ports, and
  - waste water drain mast.

Rain removal is provided for the front windshield panels by wipers.

Note: Chemical rain repellent systems have been deactivated.

Engine Anti-Ice Protection System

Purpose

The engine anti-ice system prevents ice formation on the engine nacelle leading edge.

Airflow

Engine anti-ice is accomplished by ducting an independent source of bleed air to the engine nacelle leading edge. The hot air supply is controlled through an on/off valve.

Valves

Valve Control

One valve per engine is used to control the flow of engine bleed air. Each valve is manually controlled from the flight deck by its respective ENG ANTI ICE pb.

The valves automatically close if there is no air supply. In the event of AC power loss, the valves automatically open.

Valve Positions

When the engine anti-ice valve is open:

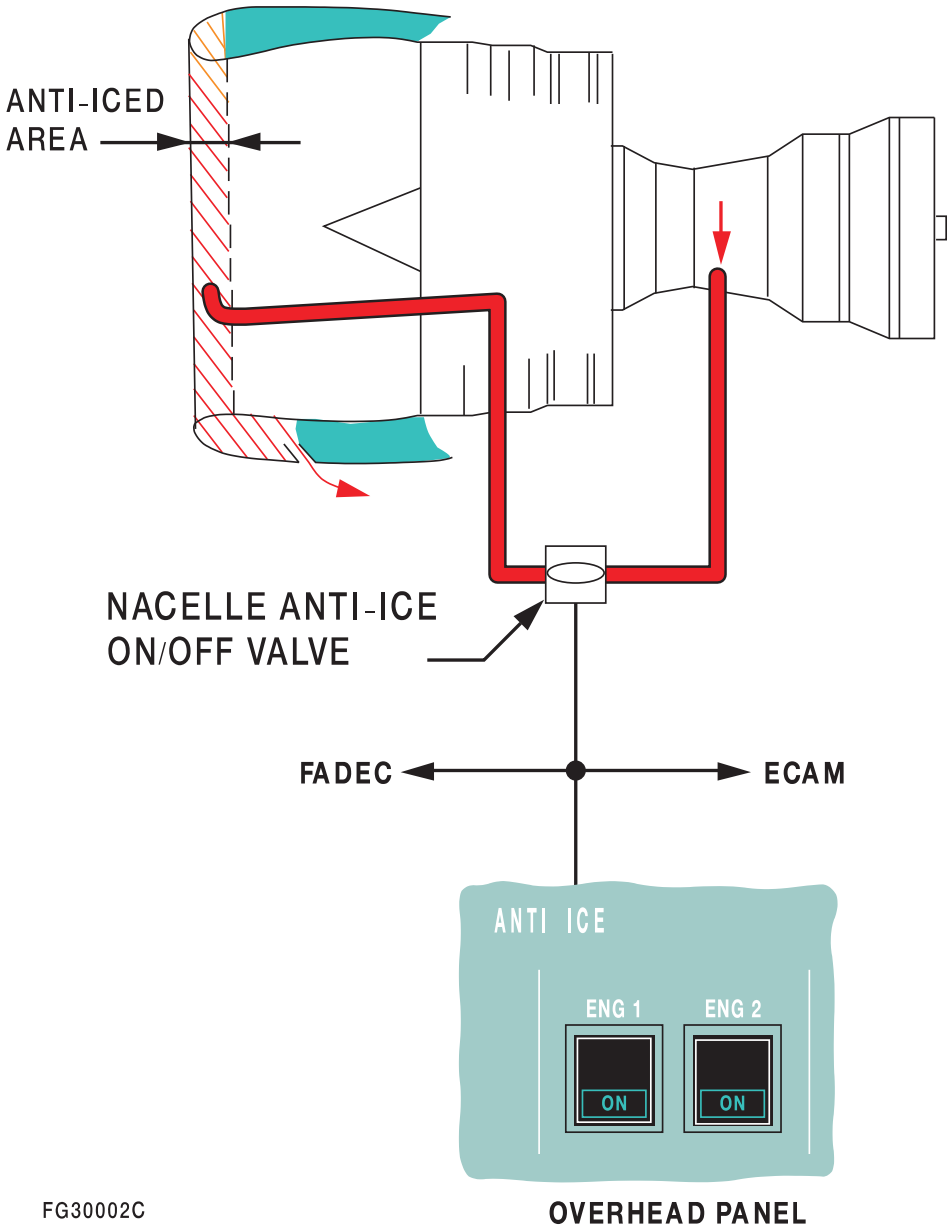
- the N_1 Limit for that engine is automatically reduced,
- an increase in engine idle speed will be noticed, and
- continuous ignition is automatically activated.

When an engine anti-ice valve is closed, pneumatic air to anti-ice that engine is not available.

Engine Anti-Ice Protection System (continued)

Diagram

The following diagram illustrates the flow of hot bleed air for engine anti-ice.



Wing Anti-Ice Protection System

Purpose

The purpose of the wing anti-ice protection system is to anti-ice or deice the three outboard wing slats. Wing anti-ice protection is provided with the slats retracted or extended.

Note: Wing anti-ice capability is reduced with the slats extended; therefore, prolonged flight in icing conditions with the slats extended is not recommended.

Airflow

Each wing receives hot, engine bleed air through its respective wing anti-ice valve to provide anti-icing.

Valves

One wing anti-ice valve per wing is used to control the flow of bleed air. Both valves are manually controlled by a single WING ANTI ICE pb in the flight deck.

Anti-ice air is vented to the slats through a tube which distributes hot air behind the slat leading edge. Anti-ice air is vented overboard through holes along the aft slat surface.

In case a leak is detected in the wing anti-ice system, the respective wing anti-ice valve closes automatically and all bleed service to the leak detected side of the aircraft is inhibited.

In the emergency electrical configuration on the A320, the wing anti-ice valves operate normally until the landing gear is lowered, at which time the wing anti-ice valves close.

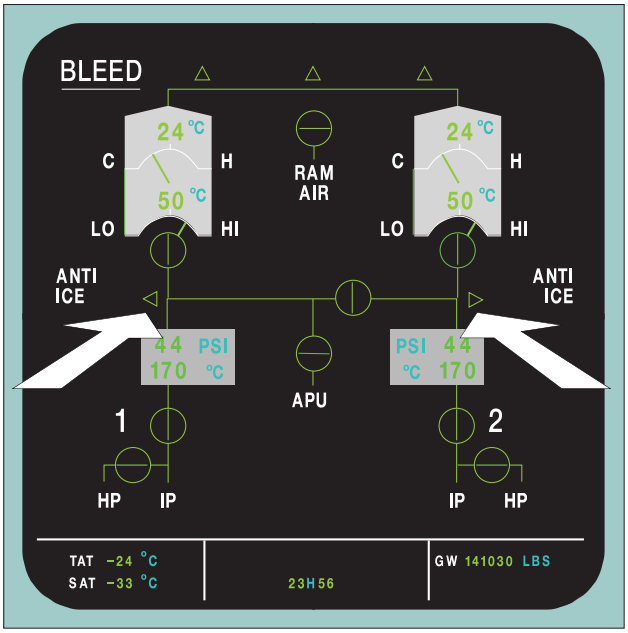
In the emergency electrical configuration on the A319, the wing anti-ice valves will operate normally as long as emergency generator power is available.

In a limited number of A320 aircraft (ship #**3209**-3211), the wing anti-ice valves automatically close in the emergency electrical configuration and cannot be reopened.

Wing Anti-ice Protection System (continued)

ECAM BLEED System Display Page

The wing anti-ice valves are displayed on the ECAM BLEED page, illustrated below.



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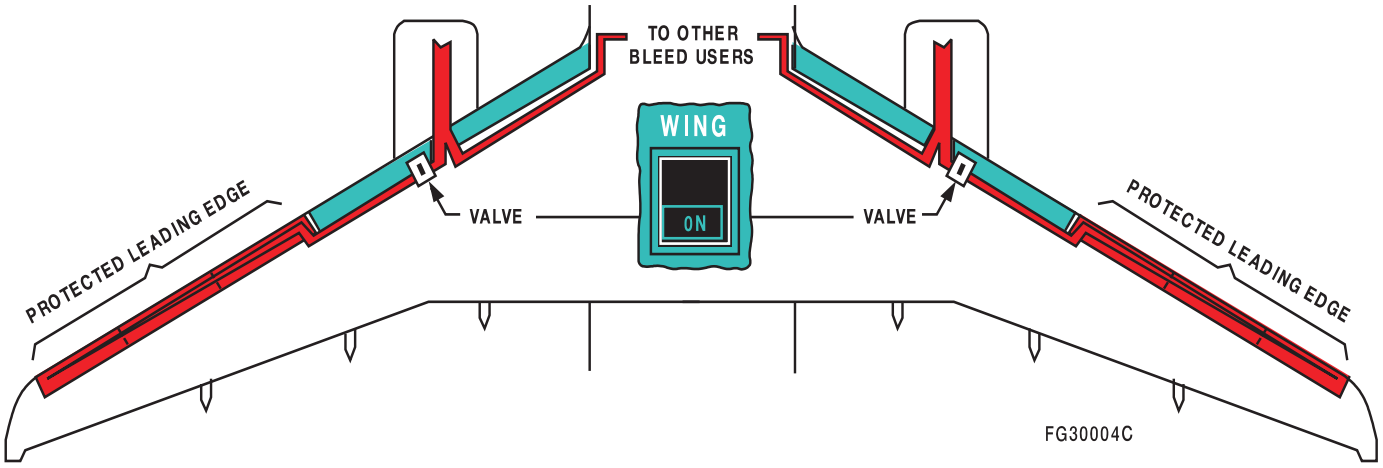
Wing Anti-ice Protection System (continued)

Bleed Air Diagram

This diagram illustrates the flow of bleed air to the wing anti-ice protection system.



Ground Operations

Although not normally used on the ground, selecting the WING ANTI ICE pb to the ON position while on the ground activates the wing anti-ice system for a short time period. During this period the following occur:

- the wing anti-ice valves cycle open and then close after a short time.
- ON is illuminated in the WING ANTI ICE pb. It will remain on until deselected by the pilot.

Note: There is no requirement to test the wing anti-ice system as described above.

Pitot/Static System Anti-Ice Protection

Purpose

The probes, pitot tubes, and static ports are anti-iced to ensure that they remain open and are able to provide data to their respective computers.

Probes/Ports Served

Probe heat computers provide overheat and fault protection. They automatically control and monitor the electric heating elements which provide anti-icing for the:

- pitot tubes,
- static ports,
- total air temperature (TAT) probes
- angle of attack probes.

Control

Probe heating occurs automatically by probe heat computers and can be manually controlled. Probes are heated automatically when at least one engine is running on the ground, or when the aircraft is in flight.

Manual selection of probe and window heat is controlled with the PROBE/WINDOW HEAT pb on the overhead panel.

Note: TAT probes are not heated on the ground. Pitot heating operates at a low level on the ground. The changeover to normal heating in flight is automatic.

Rain Removal

Windshield Wipers

A windshield wiper is provided for each windshield. The windshield wipers are driven by individual electric motors controlled by a three-position selector switch on the overhead panel.

Note: To avoid damage to the windshield, do not operate a windshield wiper on a dry windshield.

Note: The maximum speed for operating windshield wipers is 230 knots.

Window Anti-Ice and Anti-Fog System

Description

The forward windshields and side windows are electrically heated in order to provide anti-ice and anti-fog protection. The anti-ice and anti-fog system can be activated automatically or manually.

Automatic Activation

The anti-ice and anti-fog system is automatically activated whenever at least one engine is running on the ground or the aircraft is in flight. No pilot action is required.

Manual Activation

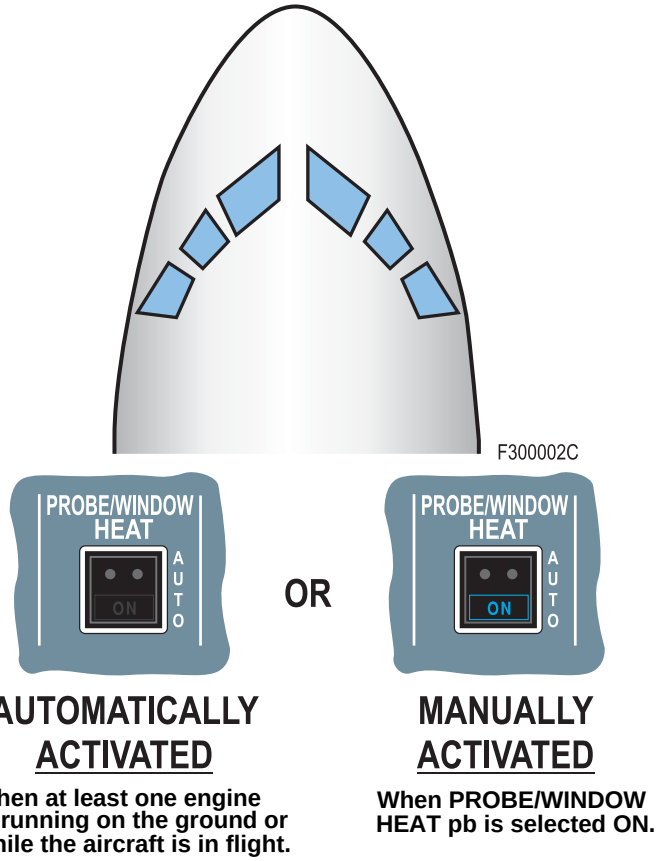
The anti-ice and anti-fog system can be manually activated prior to an engine start by selecting the PROBE/WINDOW HEAT pb to ON (Blue).

Temperature Control

Temperature control for the anti-ice and anti-fog system is automatically provided by the Window Heat Computers.

Whether the system is activated automatically or manually, the Window Heat Computers will always apply a low heat level whenever the aircraft is on the ground and shift to the high heat level when the aircraft is in flight.

Note: Manual activation while on the ground will *not* activate TAT probe heating.



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Controls and Indicators

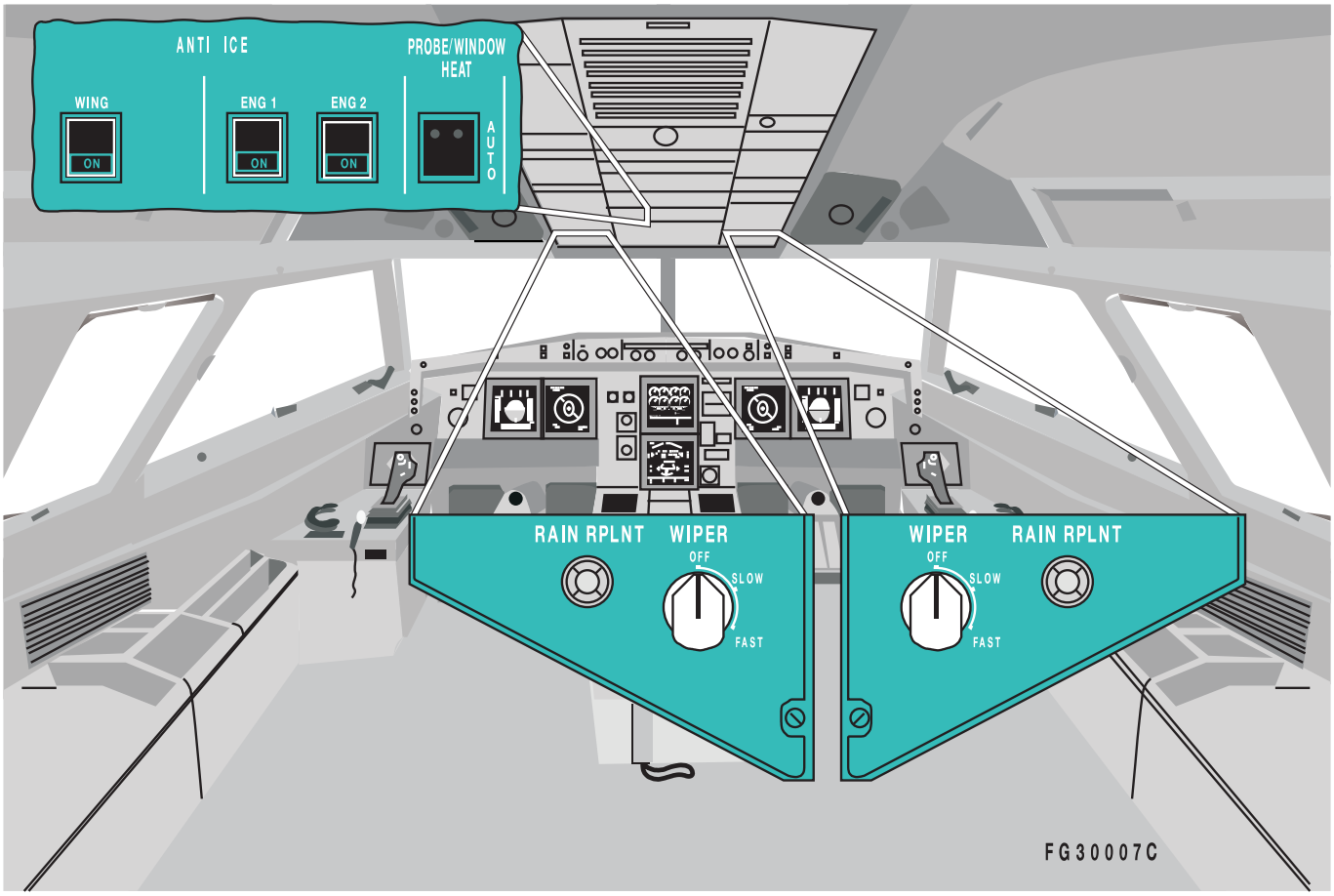
Location of Controls and Indicators

Introduction

Controls and indicators associated with the ice and rain protection system are located on the overhead panel.

Location

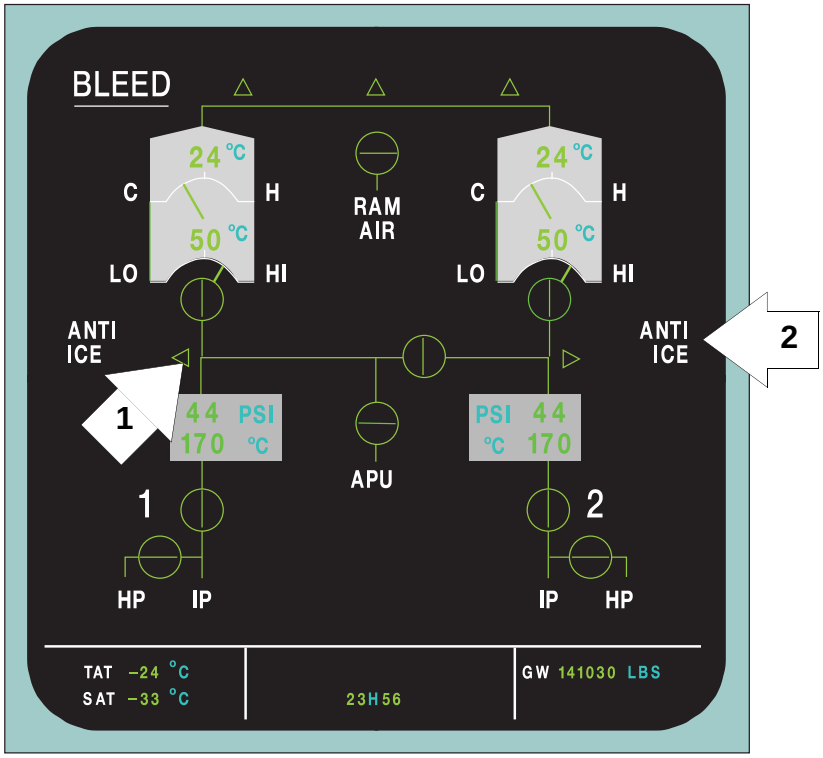
The ice and rain protection system controls and indicators are located as shown below.



Anti-Ice Indications on ECAM Pages

ECAM BLEED System Display Page

Normal wing anti-ice indications are located on the ECAM BLEED page.



FG30003C

1. Arrow

Appears when the associated anti-ice valve is open.

- Green when the aircraft is in flight, and normal wing anti-ice bleed pressure is supplied.
- Amber when the aircraft is on the ground and the valve is open for more than ten seconds, or an abnormal wing anti-ice bleed pressure is being supplied.

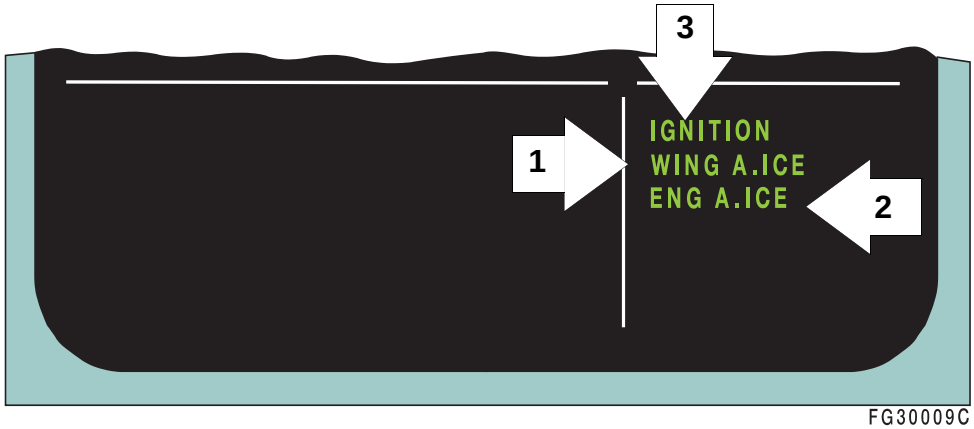
2. ANTI ICE

This indication appears in white when the WING ANTI ICE pb is selected on.

Anti-Ice Indications on ECAM Pages (continued)

Memo Section

Normal wing anti-ice, engine anti-ice, and ignition indications are located on the Memo section of the Engine/Warning Display (E/WD).



1. WING A. ICE

This message appears when the WING ANTI ICE pb is selected ON.

2. ENG A. ICE

This message appears when either ENG ANTI ICE pb is selected ON.

Note: This is the only ECAM indication for engine anti-ice.

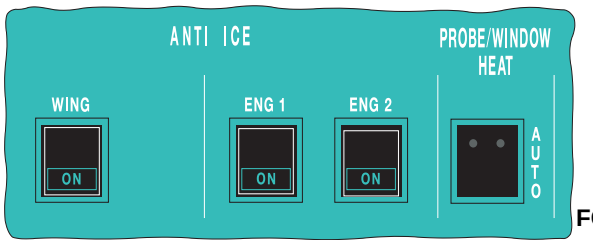
3. IGNITION

If not already displayed due to IGN/START being selected with the ENG MOD SEL selector, this message appears when either ENG ANTI ICE pb is selected ON.

WING ANTI ICE pb

Function

The WING ANTI ICE pb controls wing anti-ice for the left and right wings simultaneously and is located on the overhead panel. The following diagram illustrates the WING ANTI ICE pb.

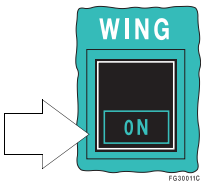


FG30010C

ON

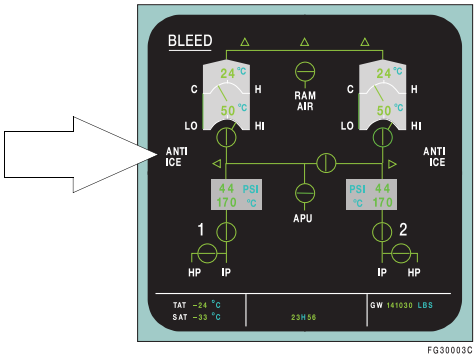
The following actions occur when the WING ANTI ICE pb is selected on:

- The “ON” light illuminates blue.
- The wing anti-ice control valves open provided a pneumatic supply is available. On the ground, when selected on, the wing anti-ice control valves open and close after a short time.



- “ANTI ICE” appears in white on the ECAM BLEED page.
- Green arrows appear on the ECAM BLEED page when the wing anti-ice valves are open.

FG30012C



FG30003C

- The “WING A. ICE” indication appears in the ECAM MEMO section.

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WING ANTI ICE pb (continued)

Off (lights out)

The following actions occur when the WING ANTI ICE pb is selected off:

- The ON light extinguishes.
- The wing anti-ice control valves close.
- The WING A. ICE ECAM indication disappears.

FAULT Light

An amber FAULT light in the WING ANTI ICE pb indicates:

- an anti-ice control valve position disagrees with the required position or
- abnormal pressure is detected.

Additionally, an amber arrow appears on the ECAM BLEED page and, unless the indications are inhibited, an appropriate message(s) appears on the ECAM STATUS page, as shown below:

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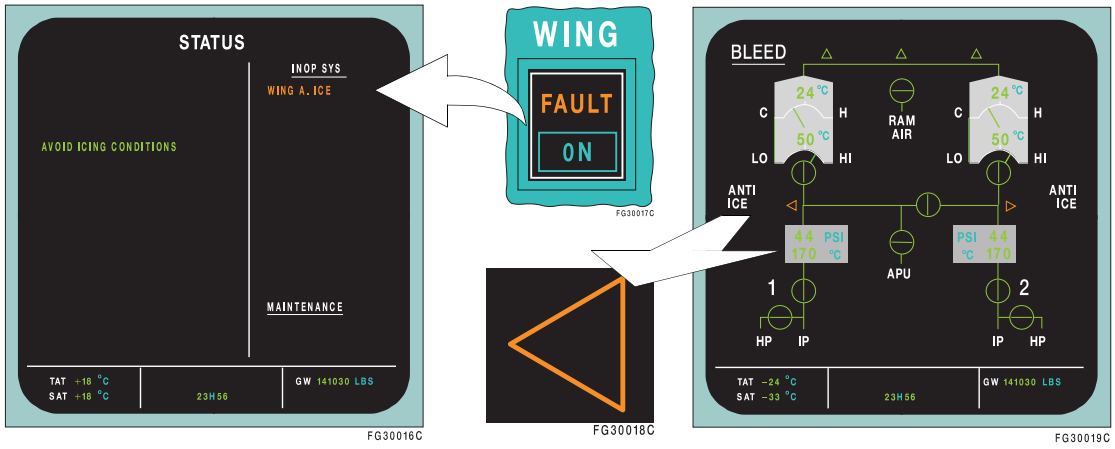


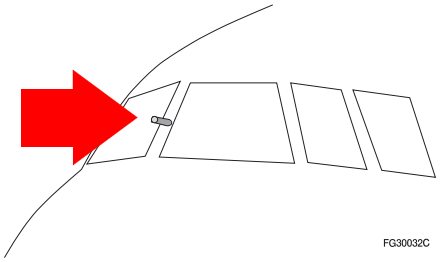
Note: FAULT illuminates amber momentarily during valve transit.

Structural Ice Indicator

A Structural Ice Indicator is located on the exterior of center windshield post. The indicator can be viewed from either the captain or first officer position.

With the accumulation of ice on the indicator, it can be assumed that ice is also accumulating on other exterior surfaces as well.

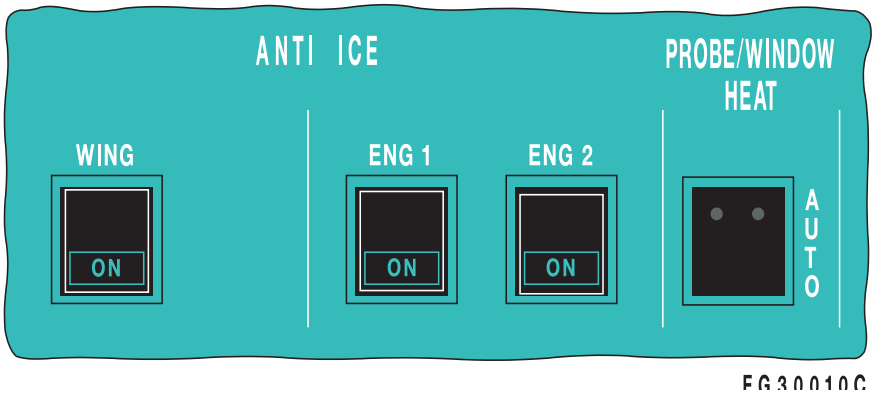
On some A320s and all A319s, the structural ice indicator is equipped with a light to improve viewing in low light conditions. The light is controlled by the use of the ICE IND & STBY COMPASS switch located on the overhead panel.



ENG 1 (2) pbs

Function

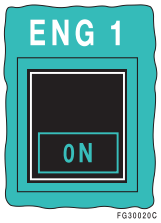
Each ENG ANTI ICE pb controls the respective engine anti-ice valve. The following diagram illustrates the ENG ANTI ICE 1 and 2 pbs on the overhead ANTI ICE panel.



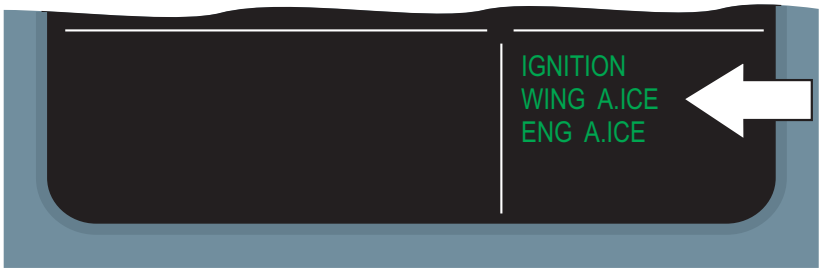
ON

The following actions occur when the ENG ANTI ICE pb is selected on:

- The engine anti-ice valve opens, provided the engine is running.
- The “ON” light illuminates blue.



- Continuous ignition is automatically activated when the valve is opened, and the message “IGNITION” appears on the E/WD.
- The message “ENG A. ICE” appears on the E/WD.



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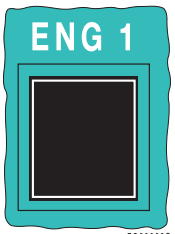
ENG 1 (2) pbs (continued)

Off

The following actions occur when the ENG ANTI ICE 1 or 2 pb is selected off.

- The “ON” light extinguishes.

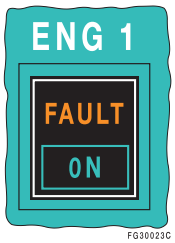


- The engine anti-ice valve closes.
- The “ENG A. ICE” ECAM message disappears.
- IGNITION is no longer active and not displayed on the ECAM.

FAULT Light

An amber “FAULT” light indicates that the engine anti-ice valve position disagrees with the ENG ANTI ICE pb selection.

Unless the indications are inhibited, indications appear on the ECAM BLEED and STATUS pages.

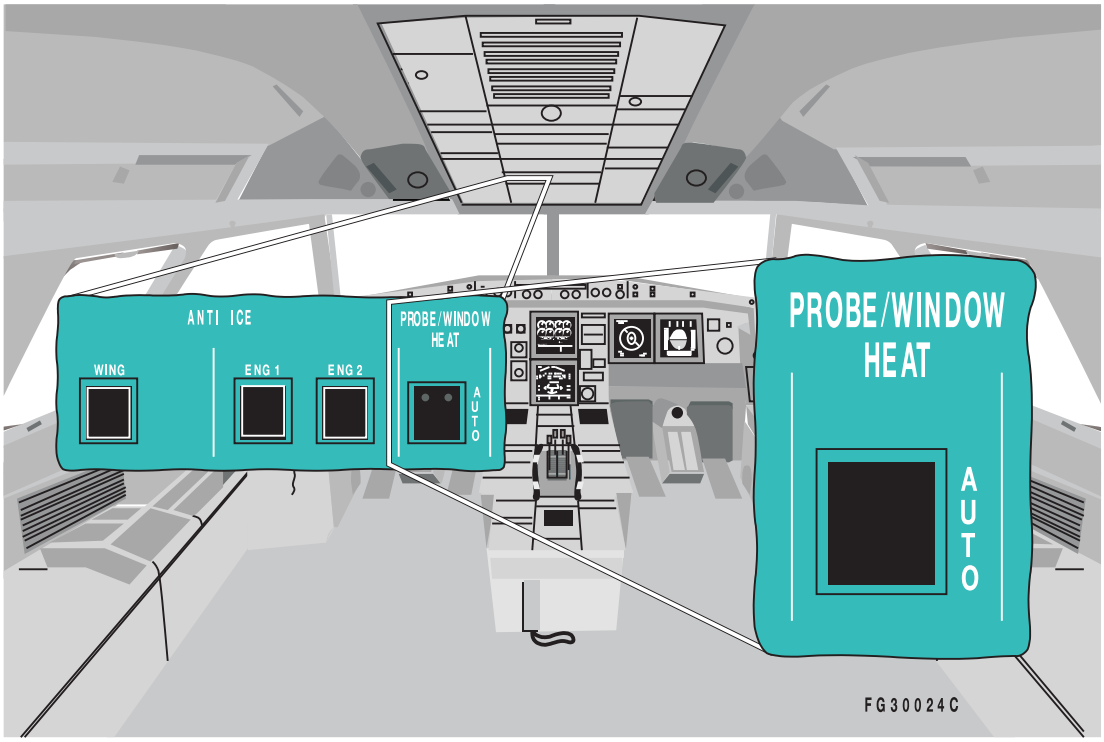


Note: “FAULT” illuminates amber momentarily during valve transit.

PROBE/WINDOW HEAT pb

Function

The PROBE/WINDOW HEAT pb controls the heating of both the probes and windows. It is located on the overhead panel adjacent to the ANTI ICE panel. The following diagram illustrates the PROBE/WINDOW HEAT pb.



AUTO

When the PROBE/WINDOW HEAT pb is placed in the AUTO (lights out) position, the probes and windows are heated automatically on the ground provided one engine is running or when the aircraft is in flight.

ON

The following actions occur when the PROBE/WINDOW HEAT pb is selected on.

FG30025C

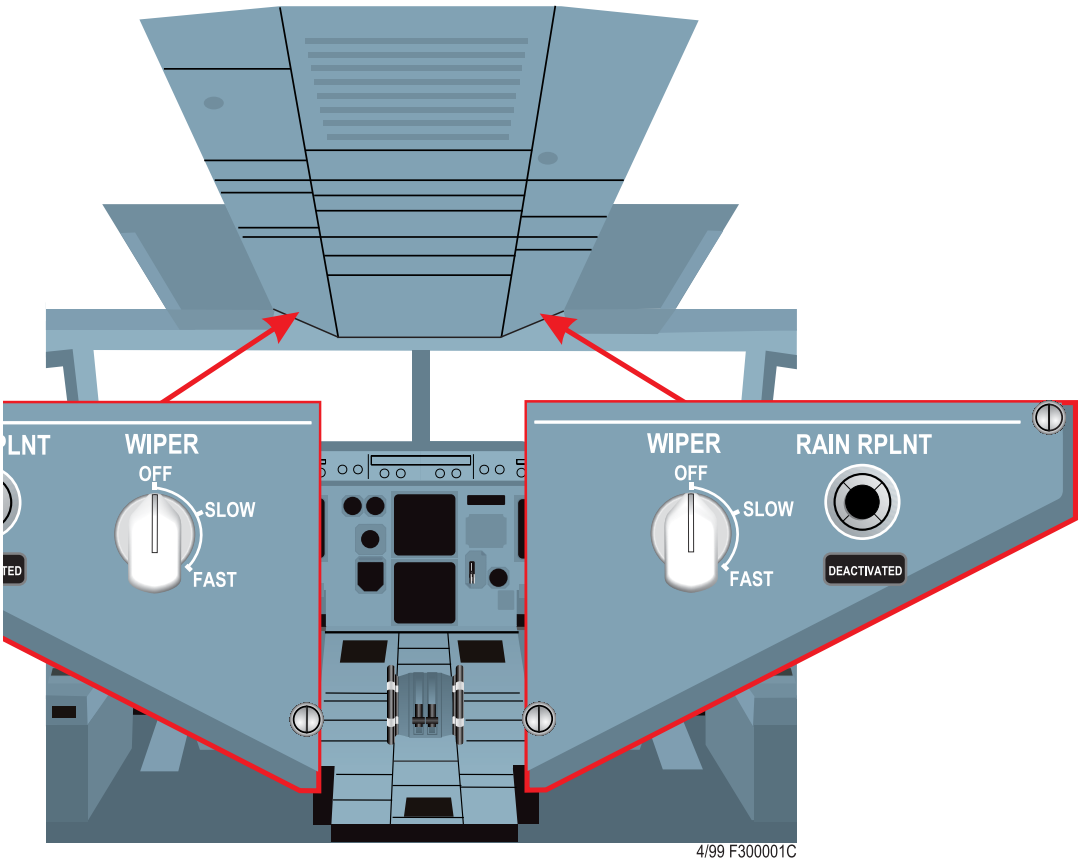
- The “ON” light illuminates blue.
- The probes and windows are heated.

Note: TAT probes are not heated on the ground. After engine start, the probe and window heat will not transition to automatic operation until the PROBE/WINDOW HEAT pb is selected to the AUTO (lights out) position.

Rain Control Panel Controls

Diagram

The diagram below illustrates the rain control panel. The panels are located on the forward overhead panel, one above each pilot.



RAIN RPLNT pb

This pb has been deactivated.

WIPER Rotary Selector

The rotary selector controls the respective windshield wiper. A SLOW or FAST speed may be selected.

When the selector is placed to OFF, the wiper is stored out of view.

RAIN RPLNT Bottle

The bottle has been removed from the flight deck (previously installed on the bulkhead behind the captain).

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Chapter 31: Flight Instruments

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System Description

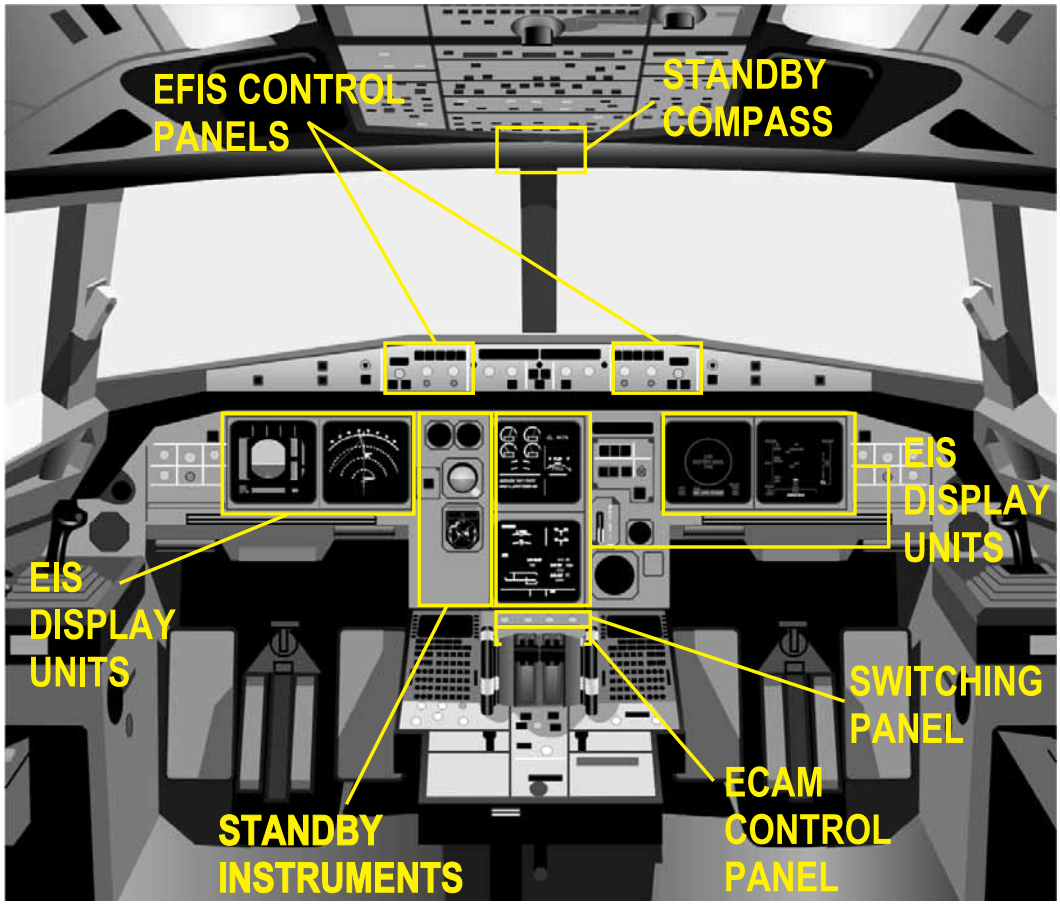
Location of Components

Introduction

Components associated with the Electronic Instrumentation System (EIS) and standby instruments consist of the following:

- Electronic Instrumentation System (EIS) display units
- Electronic Centralized Aircraft Monitor (ECAM) control panel
- Switching panel
- Electronic Flight Instrument System (EFIS) control panels
- Standby instruments
- Standby compass

These components are located throughout the cockpit, as shown below.



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Flight Instrument System

General

The flight instrument system is composed of the Electronic Instrument System (EIS) and the standby flight instruments. The EIS presents data on six identical display units, referred to as cathode ray tubes (CRTs).

The EIS is composed of two subsystems, the electronic flight instrument system (EFIS), and the electronic centralized aircraft monitor (ECAM).

The EFIS provides the pilot with all normal flight instrument and navigation displays.

The ECAM provides the pilot with aircraft system displays, fault monitoring, and corrective procedure checklists. The upper ECAM display is the Engine/Warning Display (E/WD). The lower ECAM display is normally the System Display (SD).

The standby flight instruments are provided for the unlikely event of total EFIS failure. The standby flight instruments are:

- airspeed indicator,
- altimeter,
- horizon,
- DDRMI, and
- compass.

Flight Instrument System (continued)

Display Units

There are six identical Cathode Ray Tubes (CRTs) installed on the instrument panel, referred to as Display Units (DUs).

F310269C

A blank screen indicates an individual DU has failed or been turned off. In the example below, the captain's ND has failed or is turned off.

F310270C

The display brightness is selected by the pilot with the brightness control. Each display unit has an integral light sensor which automatically compensates for changes in cockpit lighting levels.

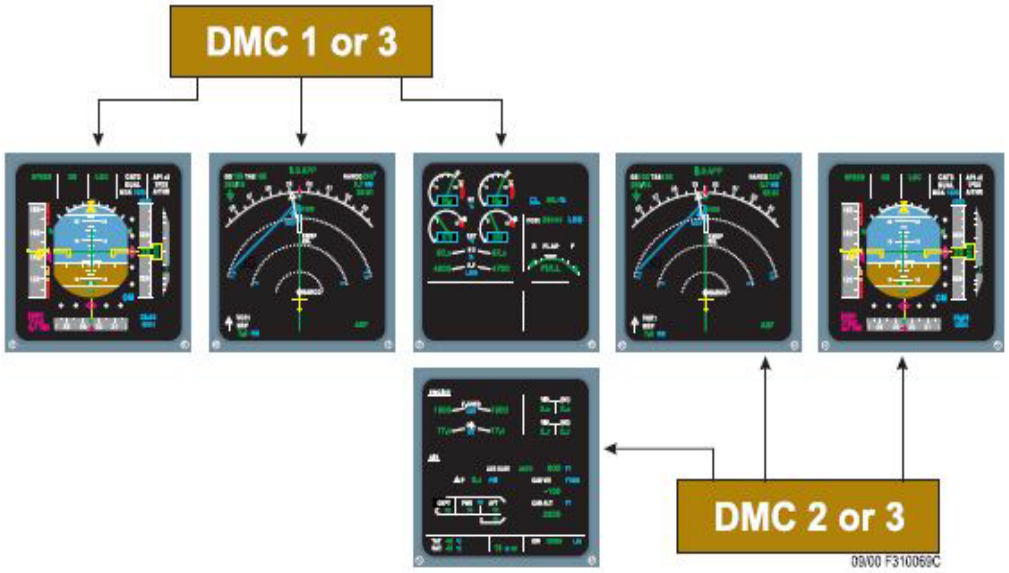
Flight Instrument System (continued)

Display Management Computers

Three Display Management Computers (DMCs) process all of the signals received from sensors and computers in the aircraft for display on the EFIS and ECAM display units.

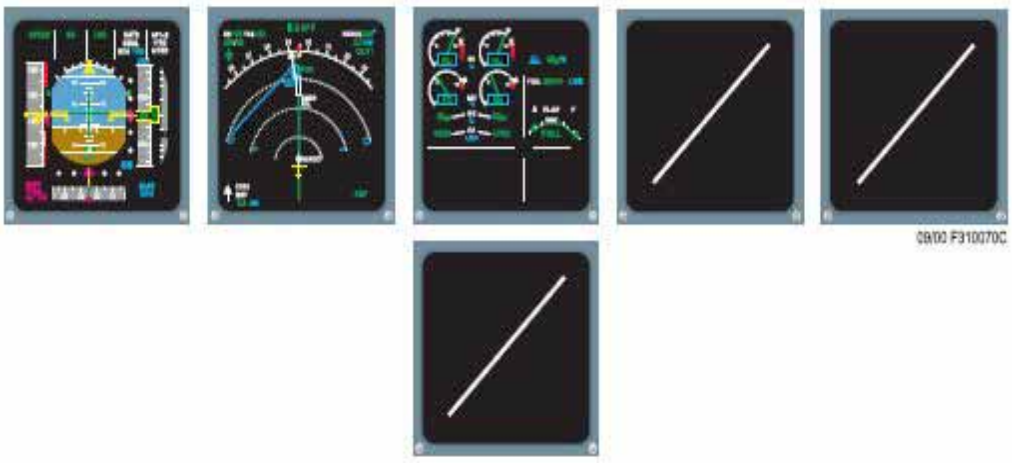
The DMCs provide information to the display units as follows:

- DMC 1 to the captain's PFD, ND and upper ECAM,
- DMC 2 to the first officer's PFD, ND and lower ECAM, and
- DMC 3 can back up either DMC 1 or DMC 2, when selected on the ECAM switching panel.



DMC Failure

The failure of a DMC is indicated by a diagonal line through all three display units supplied by that DMC. A failure of DMC 2 is shown below.



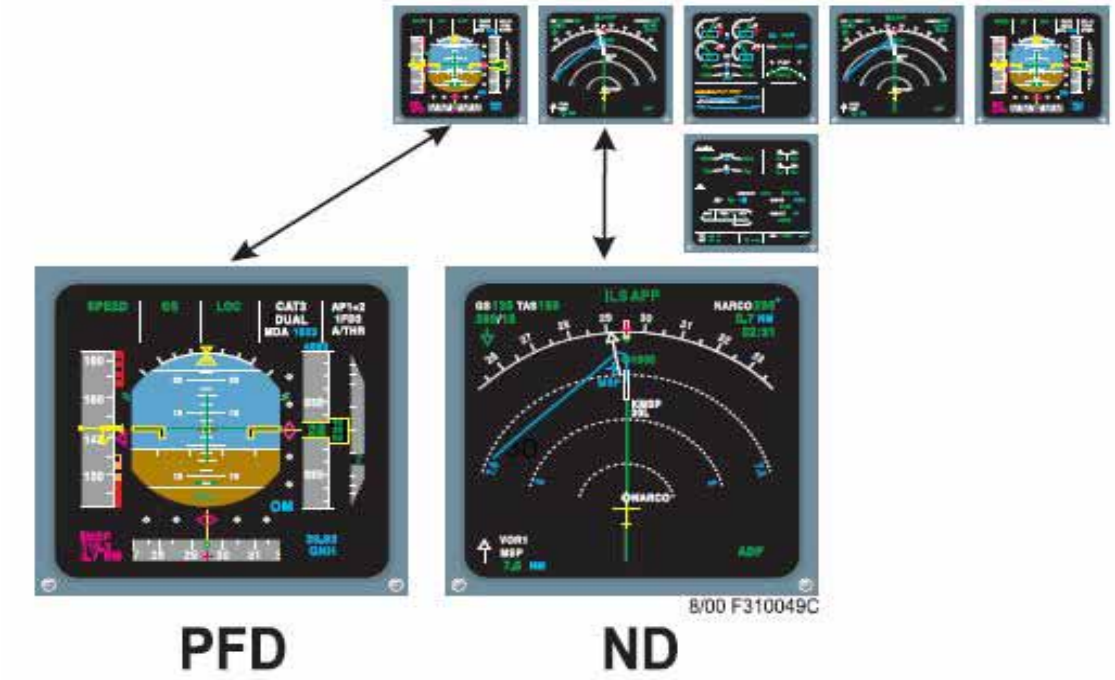
Electronic Flight Instrument System

Purpose

The purpose of the EFIS is to display flight and navigation information to the pilots.

The EFIS system utilizes two types of displays:

- the Primary Flight Display (PFD), and
- the Navigation Display (ND).



The first officer's displays and controls are configured in a mirror image to the captain's.

PFD

The PFD is the outer display unit on both the captain's and first officer's instrument panels. Information displayed on the PFD consists of the following:

- aircraft attitude,
- flight director commands,
- indicated airspeed,
- aircraft heading and/or track,
- aircraft altitude (MSL and AGL),
- aircraft vertical velocity,
- Traffic alert and Collision Avoidance System (TCAS) commands,
- vertical path indications,
- ILS information, and
- Flight Mode Annunciations (FMA).

Electronic Flight Instrument System (continued)

ND

The ND is located inboard of each PFD on the instrument panel. Information included on the ND consists of the following:

- range markings,
- flight plan,
- navigation aids,
- weather radar,
- TCAS displays (refer to chapter 85, Warning Systems),
- position,
- heading, and
- speeds (TAS and GS).

EFIS Color Codes

Colors are used on the EFIS displays to depict the importance of the indication, message, or failure, or to separate information into groups. In general, the colors correspond to colors used on the MCDU. The general rules for colors are as follows:

- **RED** - indicates a failure or condition which requires immediate crew response.
- **AMBER** - indicates a failure or condition requiring crew awareness but not immediate response.
- **GREEN** - indicates engaged flight guidance modes, flight director commands, NDB navaid information, and FMGC navigation information.
- **WHITE** - indicates titles, display scales, and VOR navaid information.
- **BLUE** - indicates armed flight guidance modes, VOR/CDI, and tuned navaid display.
- **MAGENTA** - indicates messages and indications which identify flight plan constraints, and to depict ILS navaid information.

Electronic Centralized Aircraft Monitor (ECAM)

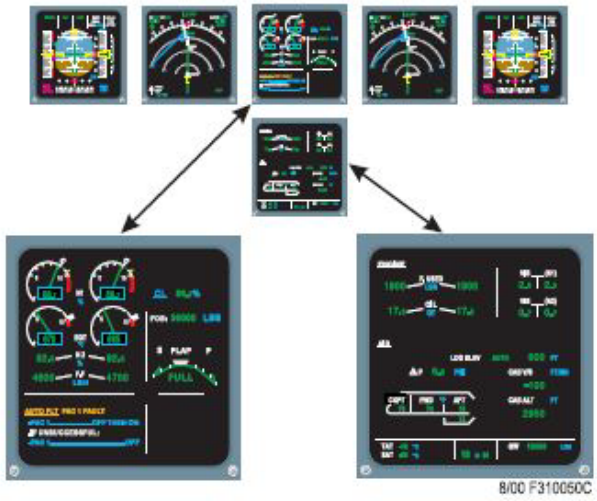
General

The ECAM system provides the pilot with aircraft system displays, fault monitoring, and corrective procedure checklists.

Information to the ECAM is provided by two primary subsystems:

- two System Data Acquisition Concentrators (SDACs), or
- two Flight Warning Computers (FWCs).

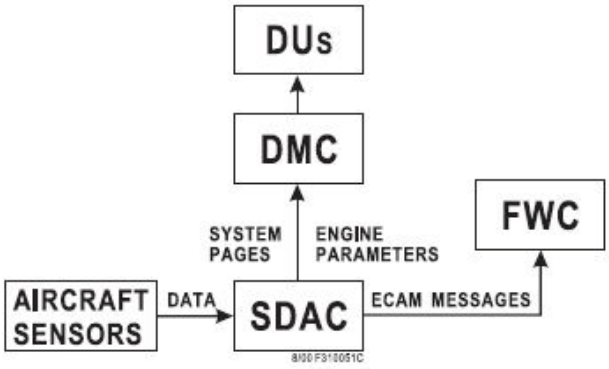
The ECAM displays consist of the Engine/Warning Display (E/WD), normally displayed on the upper ECAM, and the System Display (SD) pages, normally displayed on the lower ECAM.



SDACs

The two System Data Acquisition Concentrators (SCACs) are provided data from numerous aircraft systems. The data is displayed on the upper and lower Display Units. In addition, the data is sent to the Flight Warning Computers (FWCs) which monitor any operational exceedances of those systems and alert the crew.

Note: Either SDAC is capable of performing all required functions.



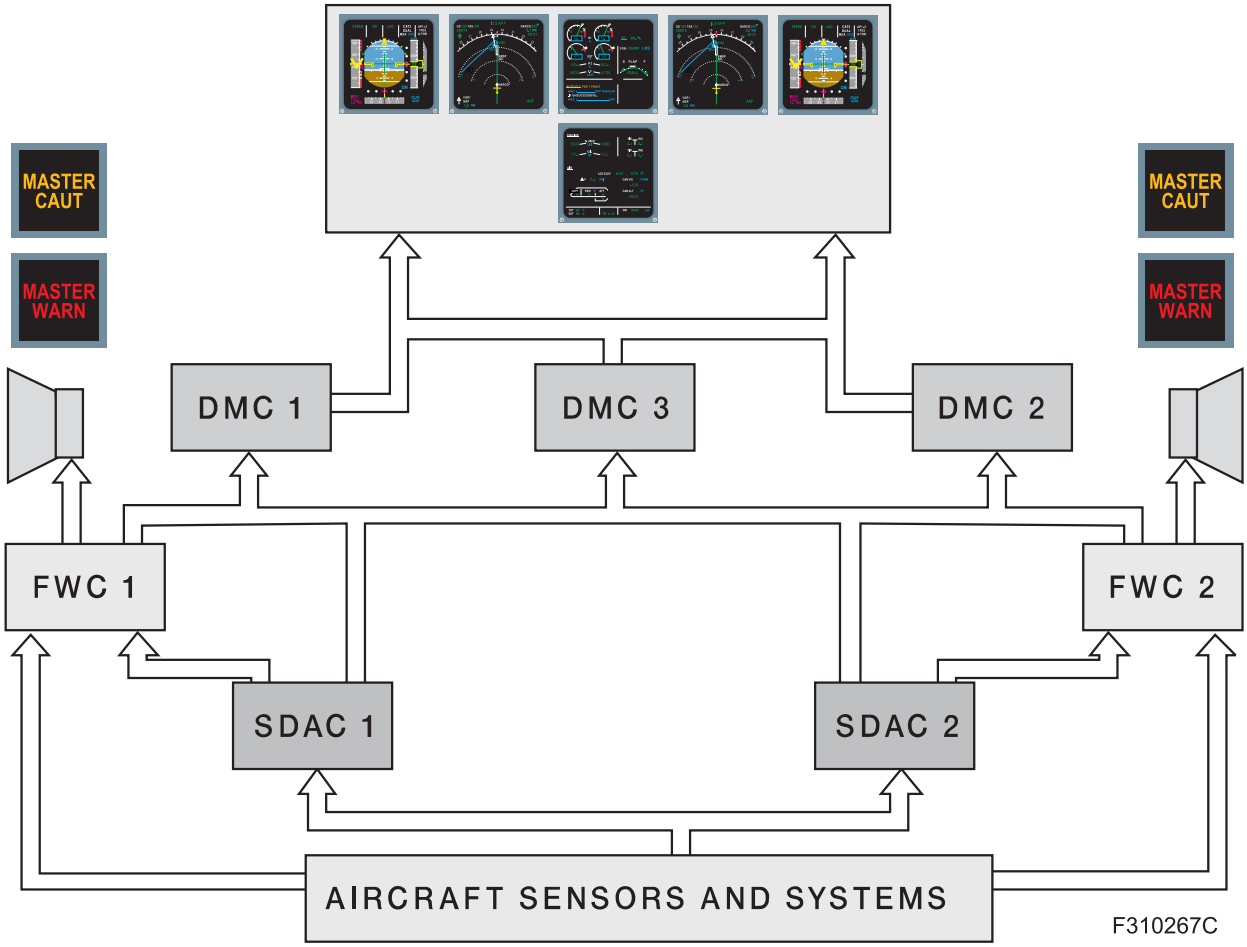
Electronic Centralized Aircraft Monitor (ECAM) (continued)

FWCs

The FWC is the primary fault warning computer. There are two FWCs. Either FWC is capable of performing all required functions. Loss of both FWCs results in the loss of most automatic failure warning capabilities.

The two identical FWCs acquire data for:

- the generation of alert messages,
- memo information display,
- aural alerts,
- radio altitude and decision height callouts,
- MASTER WARN/CAUT light illumination, or
- abnormal procedure checklists.



Electronic Centralized Aircraft Monitor (ECAM) (continued)

ECAM Color Codes

Different colors are used on the ECAM displays to depict the relative importance of an indication or failure.

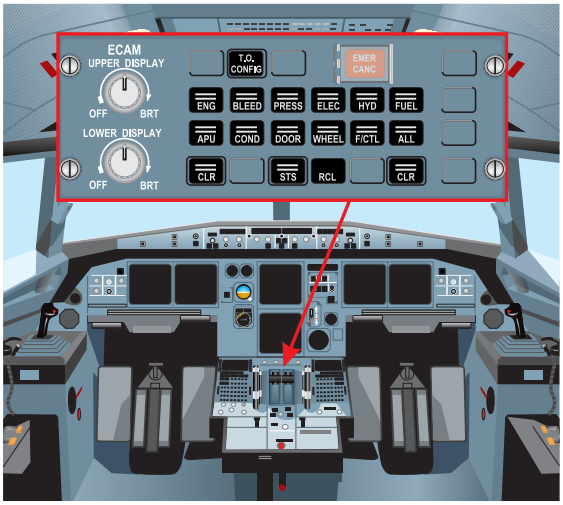
- RED - for a failure or configuration requiring immediate crew action.
- AMBER - for a failure or configuration needing crew awareness but not immediate action.
- GREEN - for normal long term operation.
- WHITE - for titles and remarks used to guide the pilot during procedures.
- BLUE - for actions to be carried out or for certain limitations.
- MAGENTA - for particular messages such as inhibition messages.

ECAM Display Controls

The ECAM displays are controlled with the ECAM control panel on the center pedestal.

The ECAM control panel allows the pilot to:

- test the takeoff configuration (T.O. CONFIG) warning,
- turn ECAM displays on and off and adjust the brightness,
- manually display system pages,
- manually display the status page,
- emergency cancel warning and cautions,
- step through abnormal ECAM procedures, and
- recall previously completed abnormal ECAM procedures.



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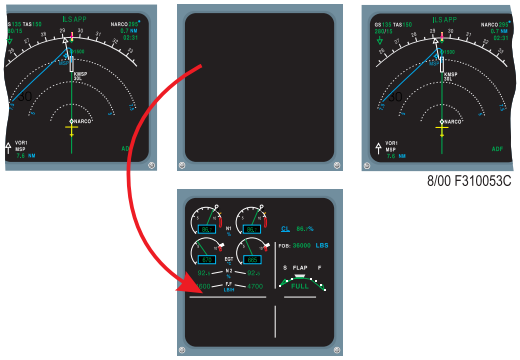
Note: The Clear (CLR), Recall (RCL), Status (STS), Emergency Cancel (EMER CANC), and ALL pbs are supplied with a different electrical supply than the system page pbs and remain operative during certain electrical system abnormals.

ECAM Display Priority

Upper ECAM Failure

The E/WD display is normally depicted on the upper ECAM, and the SD display on the lower ECAM. If the upper ECAM display unit fails, the E/WD image is automatically transferred to the lower ECAM. If the automatic transfer does not occur, turning the upper display control off will force the display to transfer.

Note: If the upper ECAM is turned off, the EFIS considers the display unit inoperative and automatically transfers the E/WD to the lower ECAM. During initial power-up, the system logic can be confused if the lower ECAM is turned on first. Therefore, during initial power-up, the upper ECAM should be turned on first.



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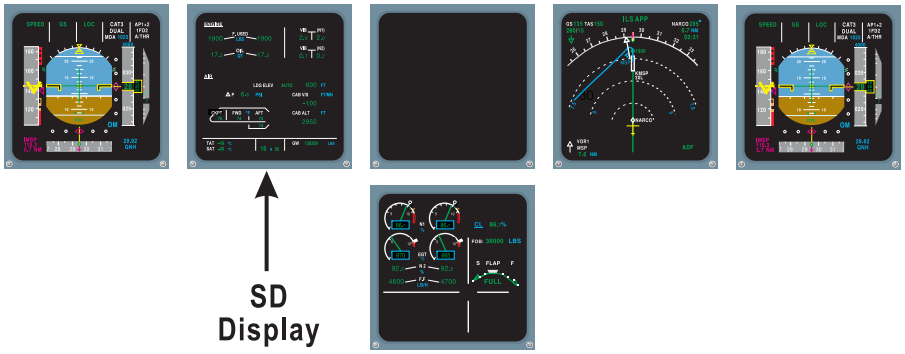
Note: The SD display may be recovered by selecting either CAPT or F/O with the ECAM/ND XFR switch on the ECAM switching panel. This transfers the SD display to the corresponding ND. The ND does not transfer to the lower ECAM display.



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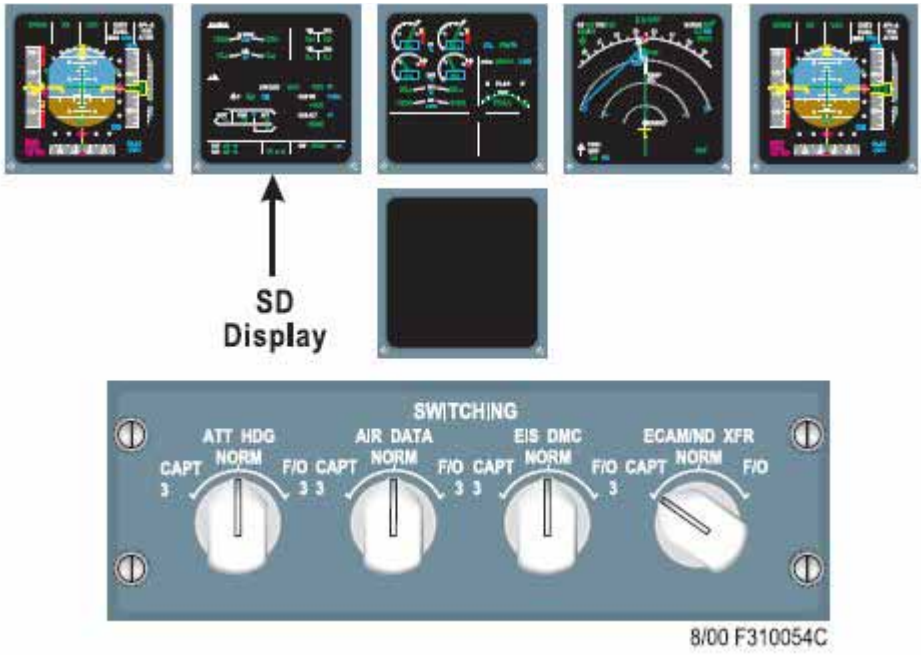
ECAM Display Priority (continued)

Lower ECAM Failure

If the lower ECAM fails, the display becomes blank. The SD image does not automatically transfer.

The SD display may be recovered as described previously by using the ECAM/ND switch on the ECAM switching panel.



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Dual ECAM Display Unit Failure

If both ECAM display units fail, the E/WD can be transferred to an ND unit by using the ECAM/ ND XFR switch on the ECAM switching panel.

The transfer of the E/WD to the ND is not automatic.

Alternate SD Display

If only one ECAM display unit is available (for example, during an electrical abnormal configuration), a system page can be displayed on the E/WD display unit by using one of two alternate methods:

- the desired SD page pb on the ECAM control panel can be pressed and held, or
- the ALL pb on the ECAM control panel can be depressed repeatedly until the desired page is displayed. The ALL pb must be held in the depressed position to display the selected page in this case.

Note: Depending on the electrical abnormal, only one of these methods may be available.

ECAM Abnormal Indications

System Description

The Flight Warning Computers (FWC), working with data received from the System Data Acquisition Concentrators (SDAC), are capable of alerting the crew of nearly 300 abnormal conditions on the ECAM display screens. These conditions are classified as Class 1 ECAM failure messages and are divided into two categories: Warnings and Cautions.

In addition, failure messages are automatically prioritizes and displayed based of the severity of the condition.

The system is also capable of alerting the crew of abnormal conditions that are not severe enough to be categorized as warnings or cautions. These are classified as advisories.

Warnings

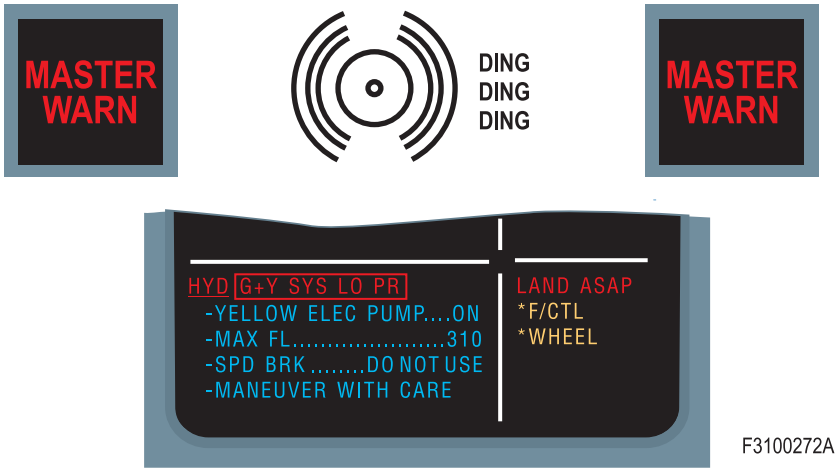
Warnings represent the most severe of all possible sensed malfunctions and therefore, require immediate crew action.

When a malfunction, categorized as a warning is detected, the crew is alerted by the following indications:

- a Continuous Repetitive Chime (CRC) sounds,
- two flashing MASTER WARNING lights,
- the associated failure message appears on the E/WD memo section (upper ECAM),
- the associated system page appears on the System Display (lower ECAM), and
- fault light/s illuminate on the associated system's control panel.

Normally, the CRC can be silenced and the Master Warning lights can be extinguished by pressing either Master Warning light pb.

Note: The CRC and Master Warning lights cannot be extinguished/silenced if the condition is associated with a Stall or Overspeed



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ECAM Abnormal Indications (continued)

Cautions

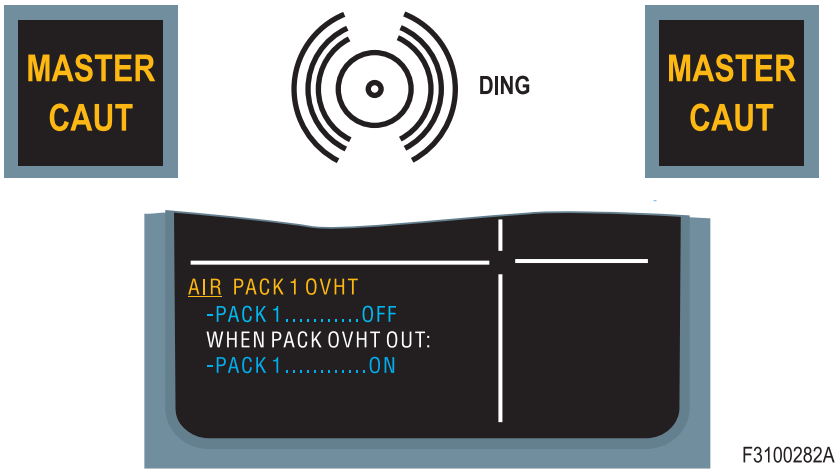
Cautions represent malfunctions which are less severe than warnings and do not require immediate crew action but must be addressed in a timely manner.

In addition, cautions are further divided into two levels; Level 1 and Level 2. A Level 2 is the most severe of the caution levels.

Level 2 Caution indications:

- a single chime sounds,
- two MASTER CAUTION lights illuminate,
- the associated failure message appears on the E/WD memo section (upper ECAM),
- the associated system page appears on the System Display (lower ECAM), and
- associated fault light/s illuminate on the overhead panel.

The Master Caution lights can be extinguished by pressing either Master Caution light pb.



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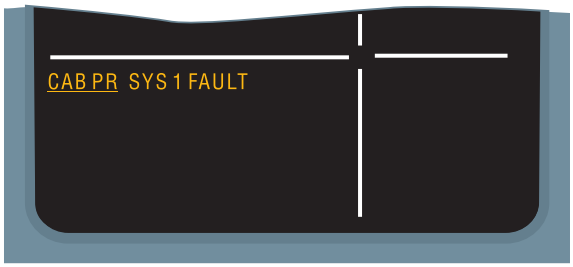
Level 1 Caution Indications:

Only the amber failure message appears on the E/WD memo section (upper ECAM). These malfunctions are typically associated with components which have automatic redundancy.



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ECAM Abnormal Indications (continued)

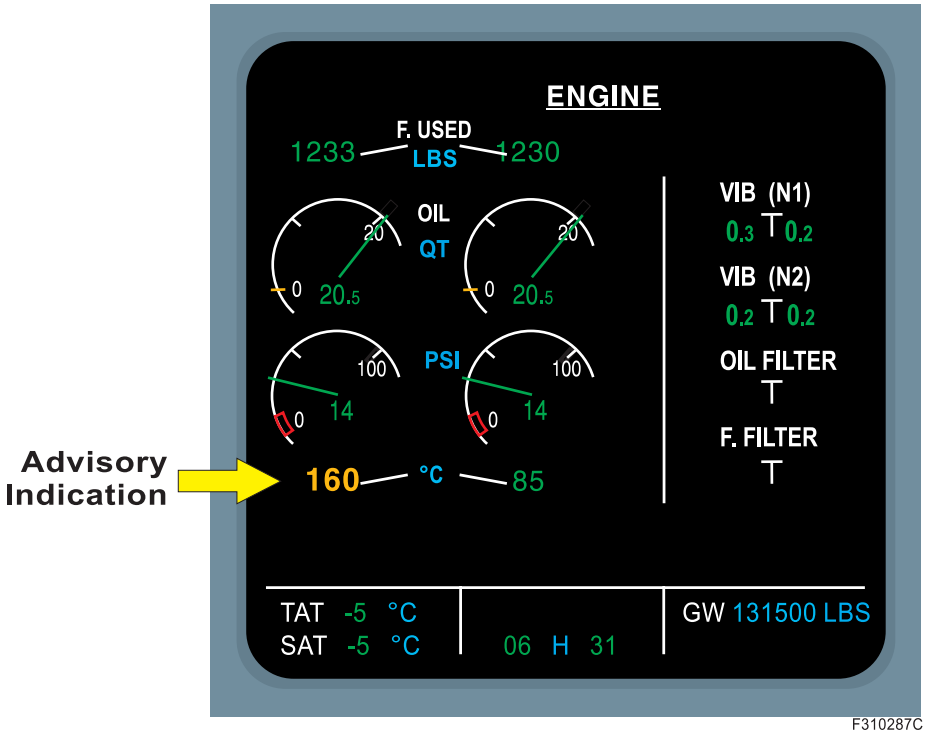
Advisories

ECAM advisories are alerts that represent particular system parameters that have degraded, but have not yet exceeded the preset limit that would trigger an ECAM failure message.

Advisories are intended to draw the crew's attention to a particular system in order to monitor the issue. Therefore, advisories do not require immediate crew action.

Advisory Indication:

- Only the associated system page appears on the lower ECAM with the particular parameter value pulsating green. Should the parameter value continue to degrade, the indication turns amber.



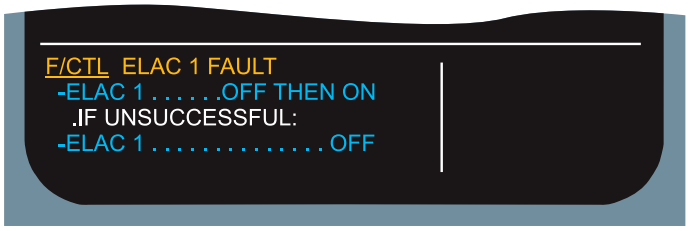
Example: Engine 1 oil temperature has increased above normal operating limits but not enough to trigger a failure message. The engine system page has automatically appeared on the lower ECAM with the engine oil temperature value in amber. Prior to turning amber, the indication was pulsating green.

ECAM Abnormal Indications (continued)

Failure Messages

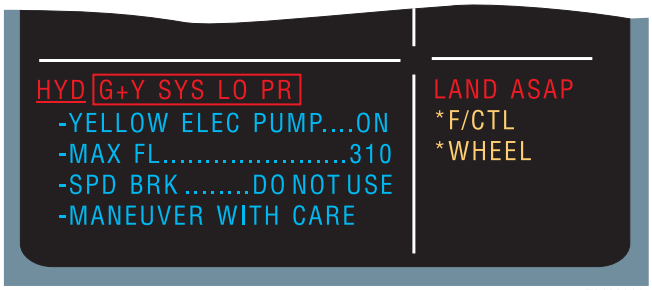
When a malfunction is detected, the respective failure message is automatically displayed on the E/WD memo section (upper ECAM). There are three types of failure messages that can be displayed: Independent, Primary and Secondary. The format of the message's title line defines the type.

Independent Failure: appear on the left side of memo section. They represent malfunctions which *do not affect* any other system or component. The title line is not boxed.



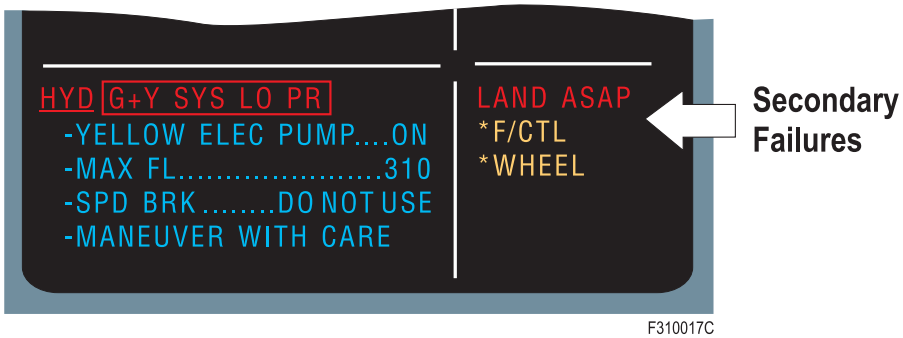
F310280C

Primary Failure: appear on the left side of the memo section. They represent malfunctions that *do affect* other systems and or components. Their appearance differs from an independent failure message in that the title line is boxed.



F310281A

Secondary Failure: appear on the right side of the memo section. They represent a list of all the systems and or components affected by the Primary failure.



F310017C

Note: As a reminder to the pilot as to the severity of the malfunction, the additional message LAND ASAP appears (Amber or Red) above the list of secondary failures.

ECAM Abnormal Indications (continued)

Failure Messages (continued)

Depending on the nature of the malfunction, the failure message may contain action steps and conditional statements.

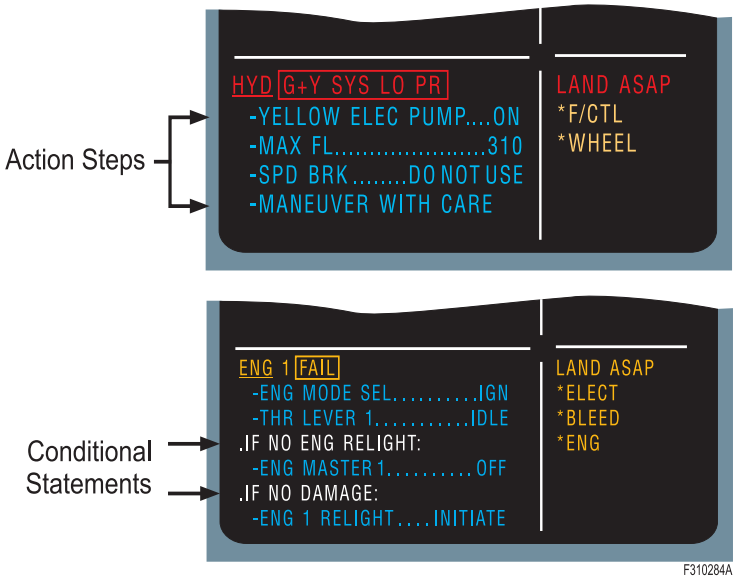
- **Action steps;** appear in blue, and represent tasks to be completed by the pilot in order to stabilize, minimize or correct the affects of the malfunction enough so to land the aircraft. Action steps fall in two categories, monitored and un-monitored:
  - **Monitored Action Steps** - are monitored by the ECAM system and therefore, when accomplished, the associated text is automatically removed from view.
  - **Un-monitored Action Steps** - are not monitored by the ECAM system and therefore, when accomplished, remain in view. These steps are generally associated with issues not having a direct effect on the malfunction as compared to monitored action steps.

Once all monitored action steps have been accomplished, the Title line and any un-monitored action steps remain in view until the malfunction no longer exists, the display has been cleared using a CLR pb or has been cancelled using the EMER CANC pb.

Note: Depending on the nature and category of the failure, there may not be any actions steps to be accomplished, and therefore only the Title line will appear.

- **Conditional Statements:** appear in white and are predicated on performing an action step/s. They provide the pilot options depending on the result of the proceeding action step/s. They may instruct the pilot to further evaluate the condition prior to continuing to the next action step.

Note: Conditional statements are automatically erased or modified based on the results of the proceeding action step



ECAM Abnormal Indications (continued)

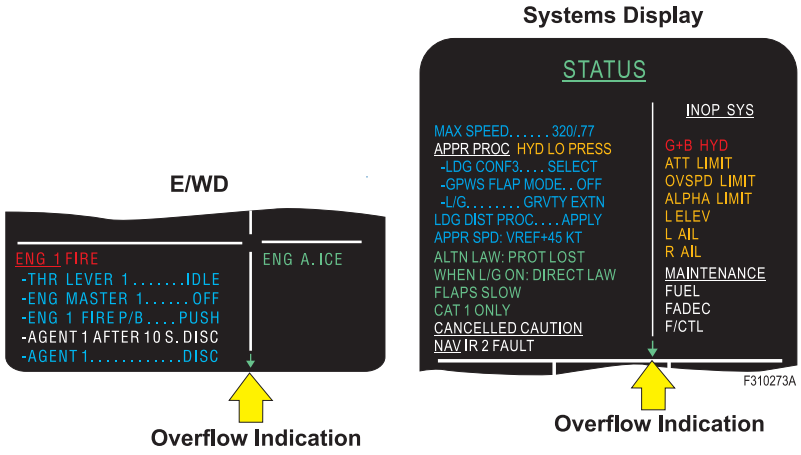
Failure Message Priority Order

The ECAM system is capable of simultaneously displaying multiple failure messages. The order in which these messages appear follows a priority order. A warning has priority over a caution and, a caution level 2 has priority of a level 1. An advisory has the lowest priority.

Overflow Indication

When there are too many failure messages to be displayed for the amount of space available on the E/WD memo section or on the lower ECAM STATUS page, a green arrow appears at the bottom of the respective screen, to alert the crew of the additional failure messages.

On the ECAM memo section, as actions steps are accomplished, space on the screen becomes available. This results in the unseen failure messages to scroll into view.



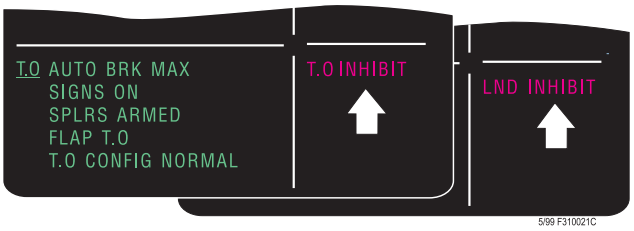
Inhibiting of Caution Messages

To avoid any unnecessary distraction during the takeoff and landing phases of flight, the Flight Warning Computer (FWC) will automatically prevent the ECAM from alerting the crew of any caution message. Once the phase of flight is complete, the crew is alerted and the caution message/s will be displayed.

During the takeoff phase, caution alerts are inhibited between approximately 80 KTS and 1500 feet. The crew is reminded that failure messages are inhibited by a memo section message T.O INHIBIT (magenta).

During the landing phase, caution failure messages are inhibited between 800 feet and touch down. The crew is reminded that failure messages are inhibited by a memo section message LDG INHIBIT (magenta).

Note: Warning messages are never inhibited regardless of the phase of flight.



ECAM Abnormal Indications (continued)

Clearing Failure Messages

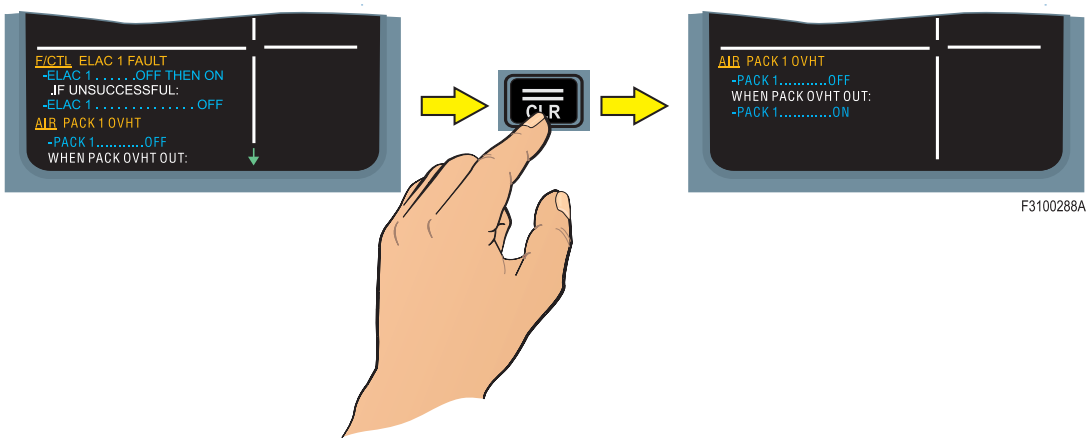
Two CLR (Clear) pbs located on the ECAM control panel can be used to erase the first underlined failure message in its entirety. It will also extinguish the MASTER WARNING /CAUTION lights.

With multiple failure messages displayed, selecting the CLR pb once will erase the first underlined failure message and any related action steps. The next failure message replaces the erased text. If the CLR pb is repeatedly selected, it will result in the clearing of all failure messages.

Note: The ECAM will not provide any reminders that a failure message has been cleared.

The cleared failure message, along with all related action steps, can be returned into view by selecting the RCL (Recall) pb. When recalled, the failure message is placed in its priority order.

Caution: *Utilizing the CLR pb prior to completing all action steps does not correct or resolve the malfunction/condition.*



Cancelling Failure Messages

The ECAM EMER CANC (Emergency Cancel) pb located on the ECAM pb located on the ECAM control panel, much like the CLR pbs, can also be used to erase failure messages. However, unlike clearing a failure message, cancelling a failure message only applies to a caution message and prevents the FWC (Flight Warning Computers) from alerting the crew of that failure for the remainder of the flight unless the failure is recalled.

Caution: *Utilizing the EMER CANC pb does not correct or resolve the malfunction/condition.*

Cancelling a Caution Failure Message:

When the EMER CANC pb is selected, the following occurs:

- the first underlined caution failure message is erased from view. The crew will not be alerted of that malfunction for the remainder of the flight unless it is recalled, and
- both Master Caution lights are extinguished.

ECAM Abnormal Indications (continued)

Cancelling Failure Messages (continued)

When a caution failure message has been cancelled, although the respective failure message has been completely removed from view, the FWCs remain aware of the cancelled malfunction. As reminder to the pilot that a caution has been cancelled, the text CANCELLED CAUTION followed by the name of the cancelled failure message appears on the Status Page on the lower ECAM.

At any time, a cancelled caution failure message can be returned into view by pressing the ECAM RCL pb for 3 seconds.

Cancelling a Warning Failure Message:

When the EMER CANC pb is selected, the following occurs:

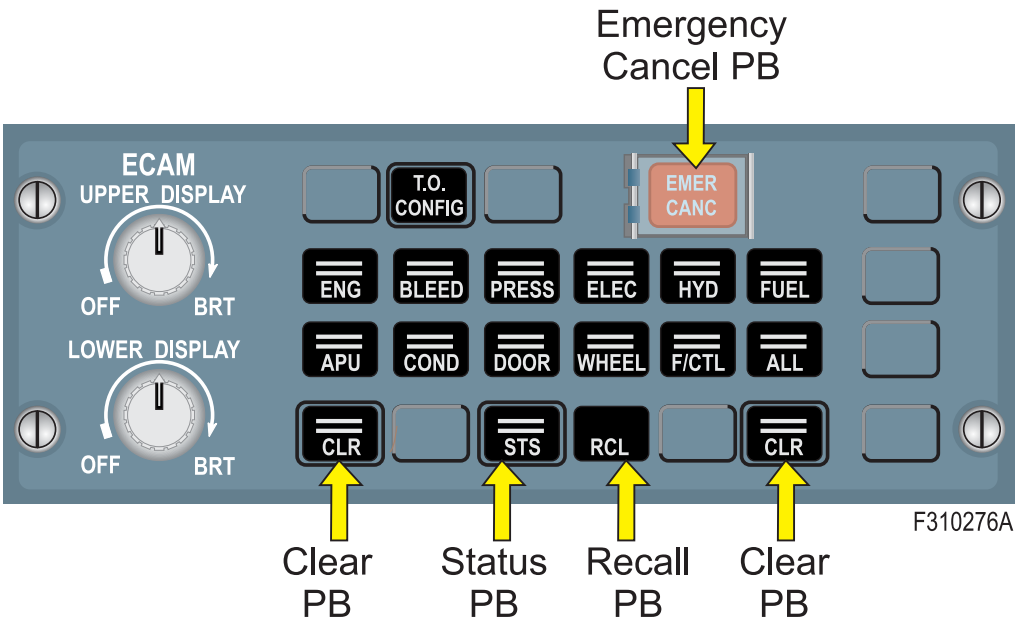
- the respective warning failure message *remains* in view until the associated action steps are accomplished or the condition is no longer being sensed,
- both Master Warning lights extinguish, and
- the CRC is silenced.

Recalling Failure Messages

When the RCL pb is selected momentarily, all failure messages which have been CLEARED, return into view along with their related uncompleted monitored action steps and all un-monitored action steps.

When the RCL pb is pressed for 3 continuous seconds, all caution failure messages which have been CANCELLED, return into view along with their related uncompleted monitored action steps and all un-monitored action steps.

ECAM Control Panel



ECAM Abnormal Indications (continued)

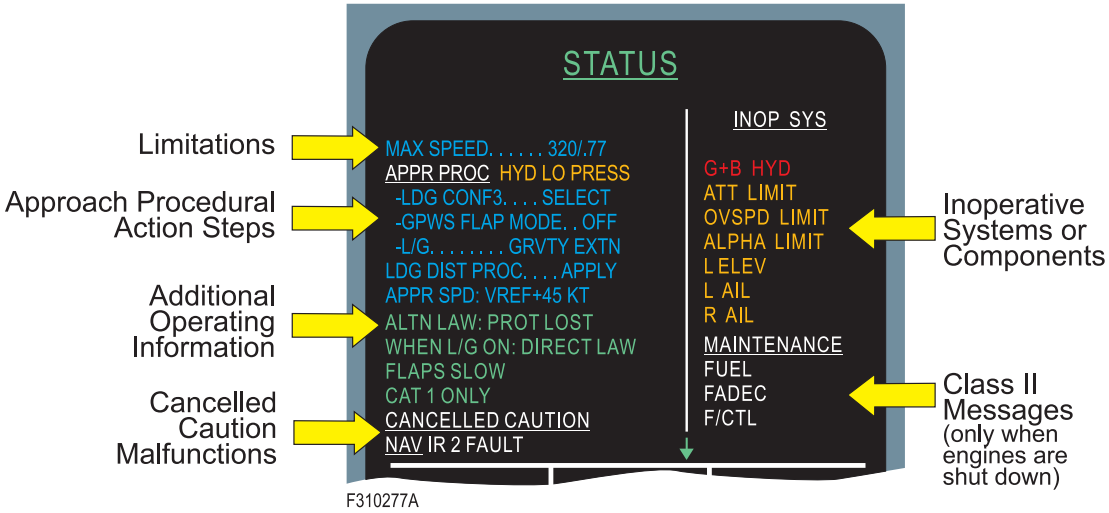
ECAM STATUS Page

The ECAM Status page is displayed on the System Display (lower ECAM) and provides an operational summary of the aircraft's status. Depending on the nature of the malfunction(s), the Status page may contain the following information:

- operating limitations (Speed, Flt Level etc.),
- approach procedural action steps (Monitored and Un-monitored) that relate to the current malfunction(s),
- additional operating information,
- list of all cancelled caution failure messages,
- list of all inoperative systems and or components, or
- list of all Class II messages (Only when engines are shutdown).

The status page appears:

- when the STS pb on the ECAM control panel is selected,
- automatically when all failure messages have been cleared, and
- automatically in the approach phase of flight when FLAPS 1 has been selected, unless no information is available.



ECAM Class II Messages

ECAM Class II messages are Maintenance Status Messages that indicate minor system faults that do not affect the dispatch capability of the aircraft. Class II messages are addressed in the aircraft's Minimum Equipment List (MEL).

The crew is informed of any Class II message on the lower ECAM Status page under the underlined title MAINTENANCE. Class II messages will only appear when both engines are shutdown.

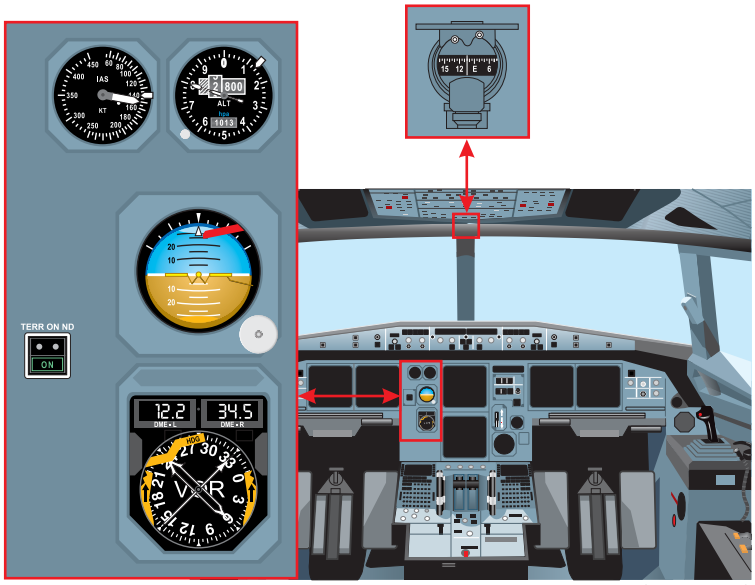
Standby Flight Instruments

General

The standby flight instruments provide for backup control of the aircraft and navigation in the unlikely event of complete EFIS failure. The standby flight instruments are almost completely independent of other electronic systems on the aircraft.

The standby flight instruments consist of the following:

- airspeed indicator,
- altimeter,
- horizon,
- Digital Distance and Radio Magnetic Indicator (DDRMI), and
- compass.



9/00 F310063C

Standby Airspeed Indicator

The standby airspeed indicator has an independent pitot-static system which bypasses the air data computers. The standby airspeed indicator is independent of the aircraft electrical system.

F310065C

Note: In the emergency electrical configuration, the standby airspeed indicator pitot heat is inoperative. If flying in icing conditions and a discrepancy exists between the airspeed displayed on the captain's PFD and the standby airspeed indicator, the PFD airspeed should be used.

Standby Flight Instruments (continued)

Standby Altimeter

The standby altimeter has an independent static system which bypasses the air data computers. The barometric pressure must be set independent of the EFIS altimeter setting. Except for the altimeter vibrator, the standby altimeter is independent of the aircraft electrical system.

F310251C

Standby Horizon

The standby horizon provides a backup attitude reference in the unlikely event of complete Intertial Reference Unit (IRU) or EFIS failure. In case of total electrical failure the standby horizon remains reliable for approximately 5 minutes.

10/02 F310256C

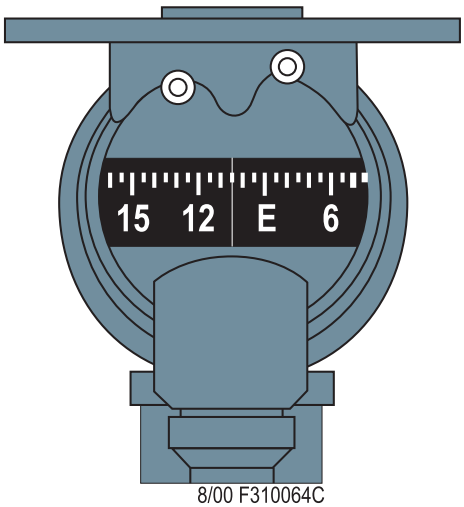
Standby Flight Instruments (continued)

DDRMI

A Digital Distance and Radio Magnetic Indicator (DDRMI) provides a backup display for VOR and DME navaids in the event of a total EFIS failure. The DDRMI heading is provided by the same Inertial Reference Unit (IRU) supplying the captain's PFD and ND (normally IRU 1).

Standby Compass

The standby compass is located at the forward edge of the overhead panel and is normally stowed. The compass is displayed by pulling down on the access panel. A deviation card is installed above the compass. The compass has lighting capability for use at night.



8/00 F310064C

Miscellaneous Systems

Overview

The miscellaneous systems include:

- Digital Flight Data Recorder (DFDR), and
- Centralized Fault Display System (CFDS).

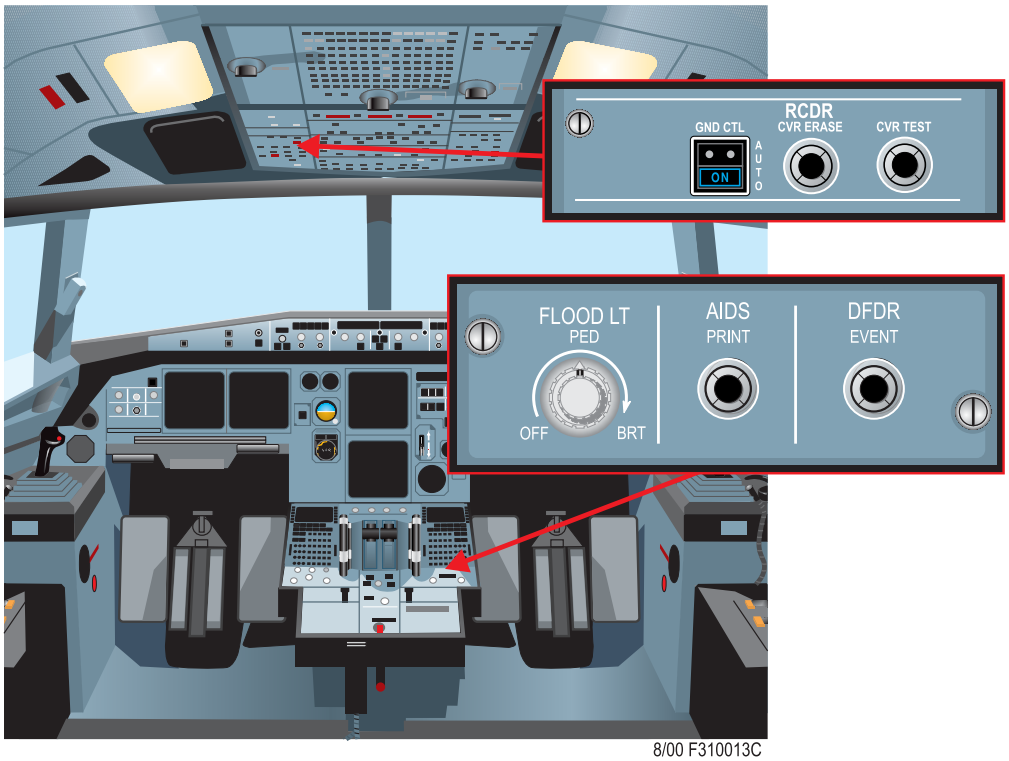
Digital Flight Data Recorder

The Digital Flight Data Recorder (DFDR) records mandatory parameters for the last 25 hours of data on a fire and shock proof tape. An underwater locator beacon is attached to the DFDR.

The DFDR is automatically energized:

- on the ground for a short period following the application of aircraft power,
- on the ground with an engine running, or
- continuously when airborne.

The DFDR is manually energized (prior to engine start) on the ground when the overhead panel GND CTL pb is ON.



8/00 F310013C

The pilot can mark the DFDR tape by depressing the pedestal DFDR EVENT pb. This allows a particular event to be easily located on the DFDR tape.

Miscellaneous Systems (continued)

Centralized Fault Display System (CFDS)

The CFDS is designed to ease the maintenance task by identifying faulty systems and by allowing certain specific systems tests. Failures which require crew action or awareness are indicated to the crew by ECAM warnings and cautions. Failures which may be deferred are called Class II failures. These Class II failures are displayed on the ECAM STATUS page in the lower right corner when the engines are shut down.

The CFDS also records failures which may be left uncorrected until the next scheduled maintenance check. These failures are not displayed by the ECAM.

Maintenance accesses the CFDS through the MCDU menu key, and can perform automatic built in test procedures on aircraft systems using the CFDS.

Failures occurring during the last leg or previous legs are easily accessible through the CFDS. The date, time and description of the failure is recorded on each leg, and can be printed if desired. CFDS access is limited and differs depending on whether the aircraft is on the ground or in flight.

Aircraft Integrated Data System (AIDS)

The AIDS system collects information from numerous aircraft systems in order to make maintenance easier. The AIDS is a data collection system, while the primary purpose of the CFDS is to identify and test faulty systems. Aircraft equipped with AIDS are capable of down linking significantly greater amounts of data to maintenance, through the ACARS system.

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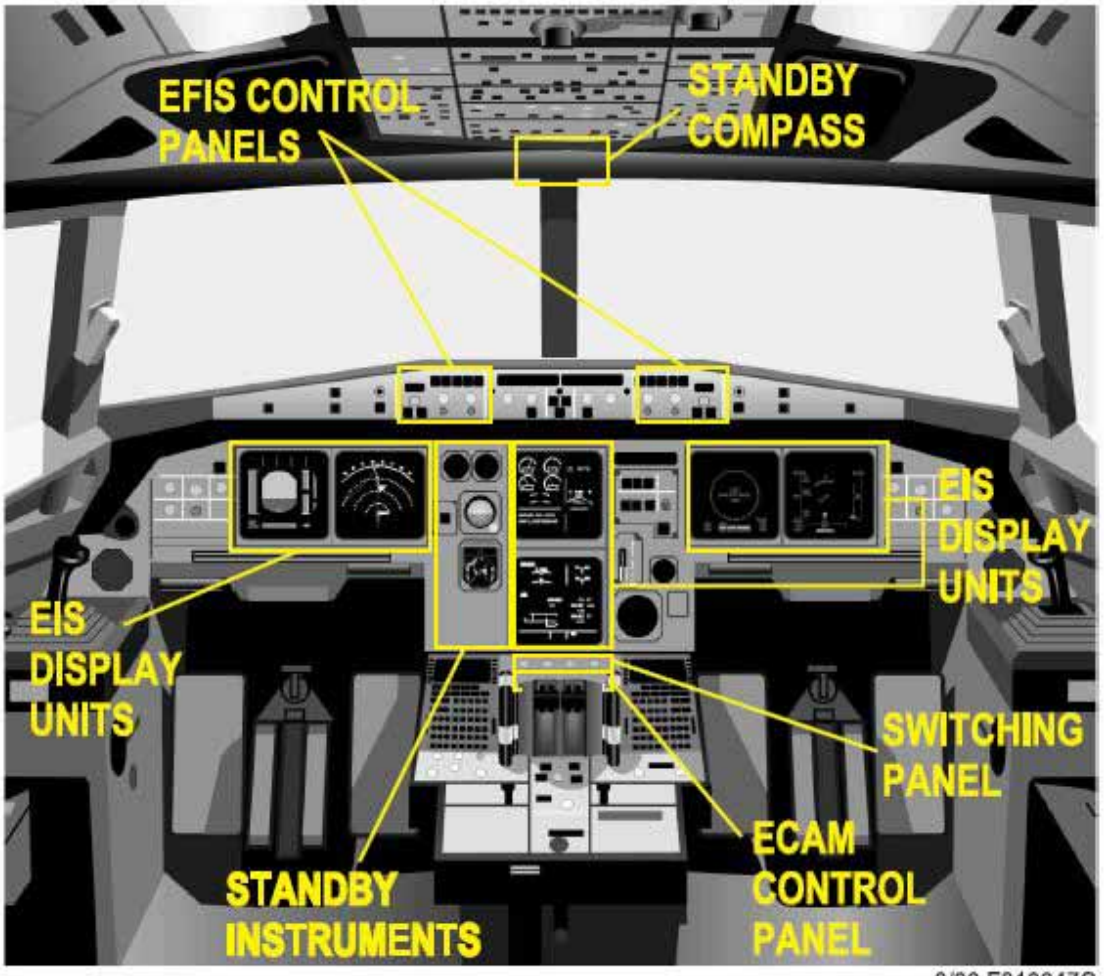
Controls and Indicators

Location of Controls and Indicators

Introduction

Controls and indicators associated with the flight instrument system are located throughout the cockpit, as shown below.



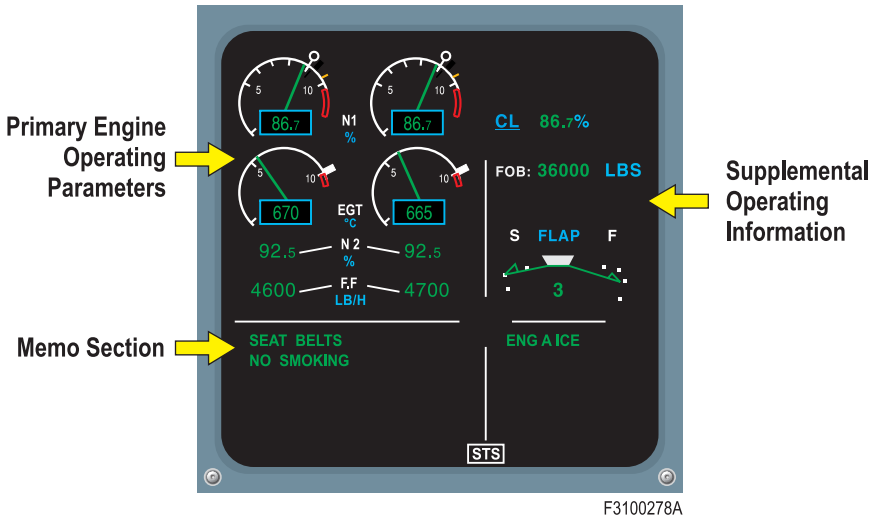
8/00 F310047C

Engine/Warning Display (E/WD)

Overview

The E/WD (Upper ECAM) is organized into three sections:

- primary engine operating parameters,
- supplemental operating information, and
- memo section.



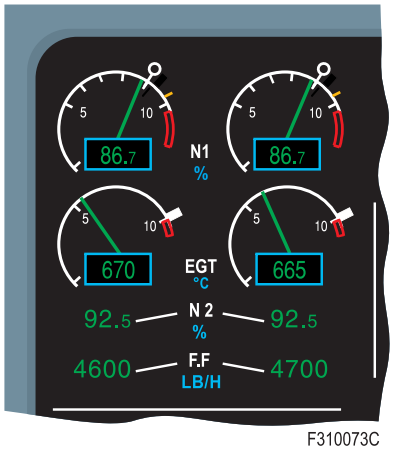
F3100278A

Primary Operating Engine Parameters

Primary engine operating parameters are continuously displayed on the E/WD as follows:

- N1 RPM,
- Exhaust Gas Temperature (EGT),
- N2 RPM, and
- Fuel Flow (F.F).

Note: Refer to Chap 72, Engines for detail information concerning engine operating indications.



F310073C

Engine/Warning Display (E/WD) (continued)

Supplemental Operating Information

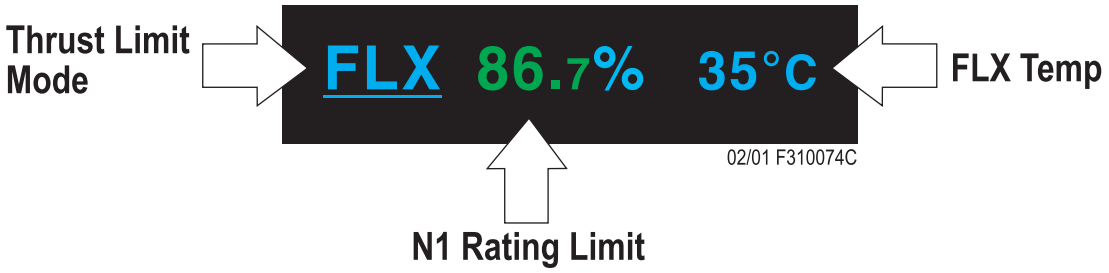
Supplemental operating information is continuously displayed and contains the following:

- engine thrust limit mode, N1 thrust limit, FLX Temp,
- total Fuel On-Board (FOB), and
- slat/flap position.

Engine thrust limit mode: represents the maximum N1 thrust output available as a result of thrust lever position. Possible displays are:

- TOGA (Take Off/Go Around Thrust),
- FLX (Flex),
- CLB (Climb),
- MCT (Maximum Continuos Thrust), or
- MREV (Maximum Reverse Thrust).

Note: In order for FLX to be displayed, a flex temperature value must be entered on the MCDU PERF Takeoff page otherwise, each engine's FADEC defaults to TOGA thrust on takeoff.



Engine/Warning Display (E/WD) (continued)

Supplemental Operating Information (continued)

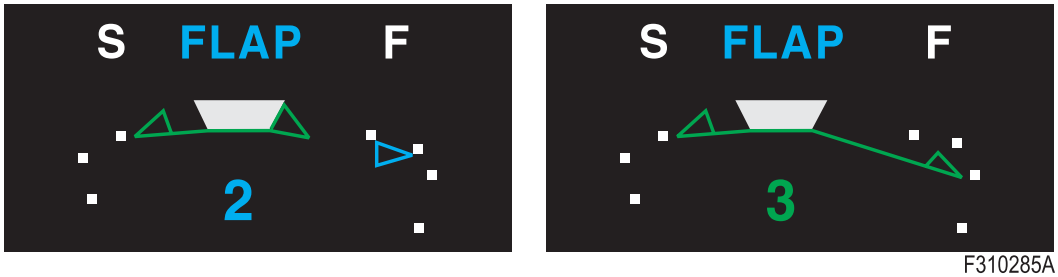
Total fuel onboard (FOB): represents actual FOB.

9/00 F310075C

Slat/Flap position: represents the selected position of the Flap handle, displayed in blue and, the actual position of the slats and flaps in green. The color amber represents a malfunction or an automatic protective safety feature of the respective surface.

The display is divided into a right and left section. The left section displays the position of the leading edge slats as represented by the letter S. The right section displays the position of the trailing edge flaps as represented by the letter F.

In addition, a numerical value is displayed representing the actual flap handle position. It is displayed in blue when the surfaces have not reached the selected position. It turns green when the surfaces have reached the selected position.



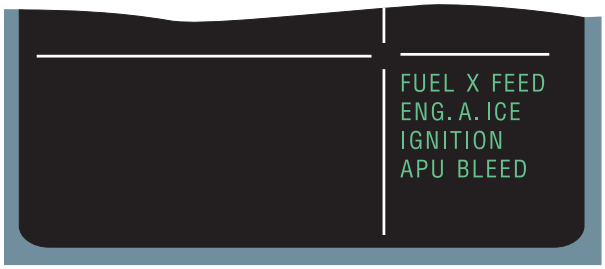
F310285A

Engine/Warning Display (E/WD) (continued)

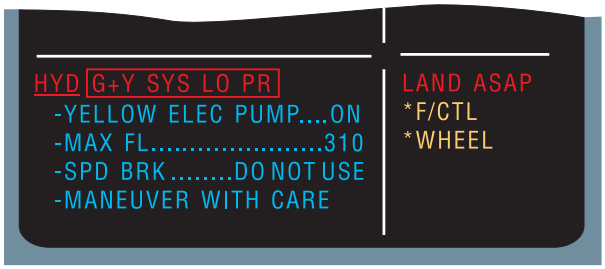
Memo Section Description

The memo section is capable of displaying normal operating condition alerts or, in the event of a malfunction, is capable of alerting the crew to Class 1 Warnings and Cautions.

Normal Operating Alerts



Class I Malfunction Displays



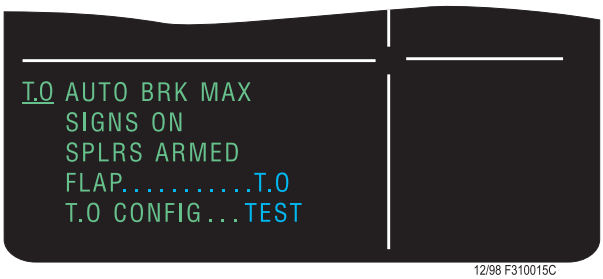
F3100279A

Takeoff Memo

The takeoff memo appears shortly after both engines have been started and the ENG MODE selector has been returned to the NORM position or after the start of one engine when the TO CONFIG pb has been selected.

The takeoff memo contains a list of items that must be accomplished prior to takeoff.

The takeoff memo is automatically removed from view when takeoff thrust is selected.



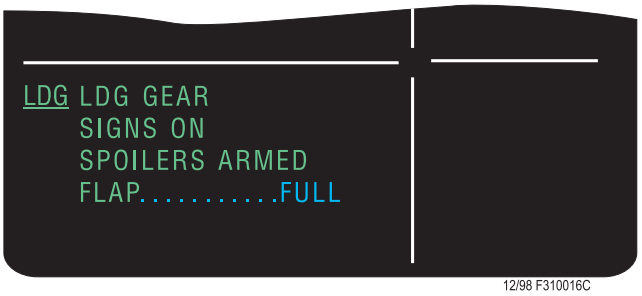
12/98 F310015C

Engine/Warning Display (E/WD) (continued)

Landing Memo

The landing memo appears when in the approach phase and below 2000 feet. It disappears after touchdown or when a go-around is accomplished.

The landing memo contains a list of items that must be accomplished prior to landing. Initially appearing in blue, as these items are accomplished, the associated text turns green.



System Display (SD)

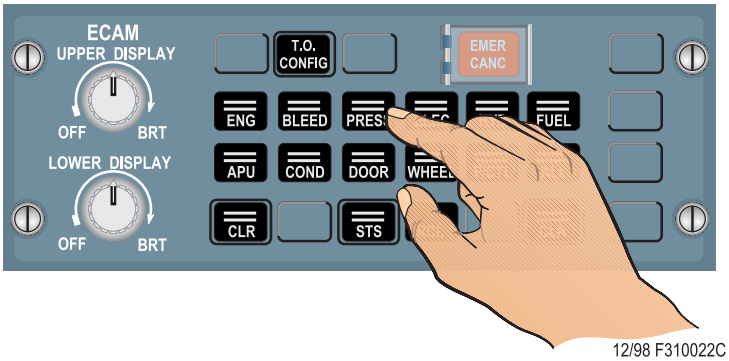
Overview

The System Display (SD) is normally displayed on the lower ECAM. The system pages that can be displayed include:

- BLEED (bleed system),
- PRESS (pressurization),
- ELEC (electrical),
- HYD (hydraulic),
- ENGINE,
- FUEL,
- APU (auxiliary power unit),
- COND (air conditioning),
- DOOR/OXY (doors/oxygen),
- WHEEL (landing gear, braking, ground spoilers),
- F/CTL (flight Controls), and
- CRUISE (common reference data from numerous systems).

Refer to the appropriate system chapter for a detailed description of each page.

An example is illustrated as follows:



12/98 F310022C

12/98 F310023C

System Display (SD) (continued)

SD Page Selection

System pages can be displayed:

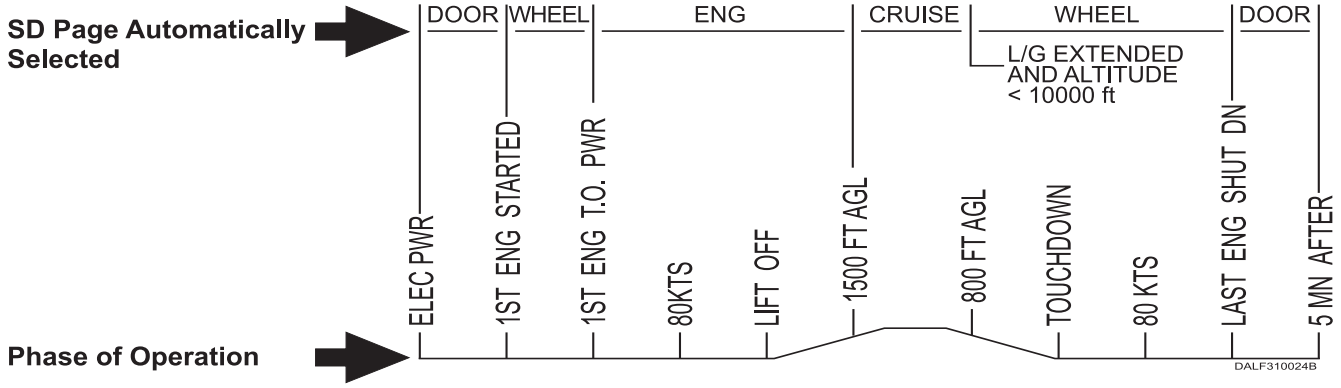
- automatically, during normal operations,
- automatically, during abnormal conditions, or
- manually.

Automatic Display Normal Operation

System pages are automatically displayed during normal operations for the related phase of flight or to allow monitoring of selected systems.

Note: Manual selection of system pages overrides automatic displays.

Phase of Flight - The system page related to the current ECAM phase of operation is automatically displayed in accordance with the diagram below:



For example, prior to engine start, the DOOR page is automatically displayed.

Note: Unlike other pages, the CRUISE page can only be displayed automatically. The CRUISE page is available only while airborne, when no other pages are displayed.

System Monitoring - The appropriate systems page is automatically displayed when a system page is required for monitoring. For example, the APU page is automatically displayed during APU start.

The system pages automatically displayed are:

- APU (during APU starts),
- ENGINE (during engine starts),
- F/CTL (during flight control inputs on the ground), and
- STS (when the slats are extended during approach with a malfunction present or at the completion of an abnormal procedures checklist).

Note: The F/CTL page is not automatically displayed after engine start if the ENG MODE selector is not returned to NORM.

System Display (SD) (continued)

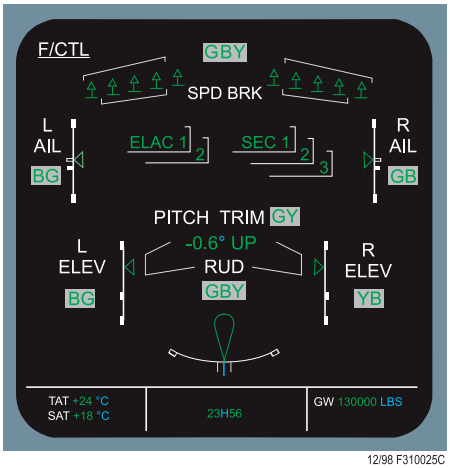
Automatic Display Abnormal Operation

The related system page is automatically displayed when a failure is detected or a system parameter exceeds the normal range.

Failure Detection - For example, if a flight control computer fails, the F/CTL page is automatically displayed.

E/WD

ECAM F/CTL System Display Page



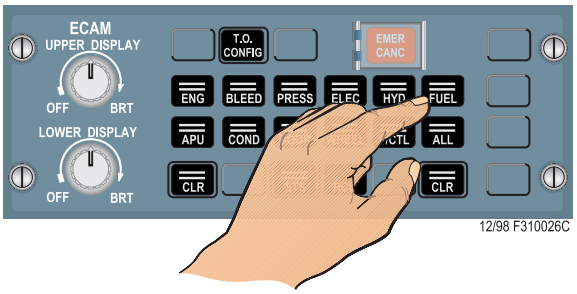
12/98 F310025C

System Parameter Exceeded - If a system parameter exceeds the normal range but has not exceeded a preset limit, the system page is displayed and the indication pulses in green.

Abnormal Procedure - During abnormal procedures (discussed later), the pilot sequences through all affected systems with the CLR pb on the ECAM control panel. Each systems page is displayed when the corresponding system is sequenced.

Manual Display

The pilot can manually select a systems page or the STATUS page by pressing the corresponding system pb on the ECAM control panel. When a systems page is selected, the corresponding pb is illuminated. The page is deselected with a second push of the pb.



12/98 F310026C

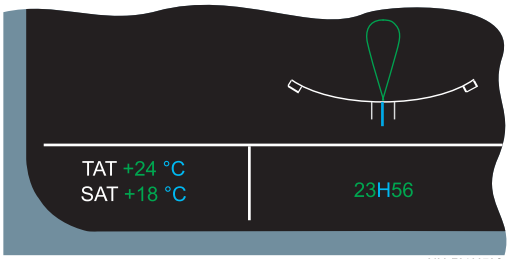
Manual selection of a systems page inhibits automatic page display. To allow automatic page display, the ECAM control panel must be in a lights out configuration.

System Display (SD) (continued)

Permanent Data Display

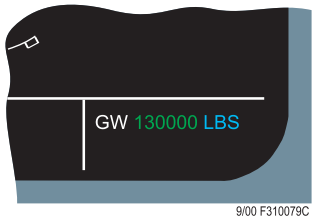
The following flight and aircraft data are always displayed on the bottom of the SD:

- Total Air Temperature (TAT),
- Static Air Temperature (SAT), and
- current UTC time. The current UTC time is synchronized with the aircraft clock. Amber “X's” are displayed when the time is unavailable.



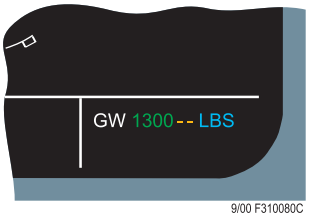
9/00 F310078C

After engine start and data entry, the Gross Weight (GW) appears in the lower right corner.



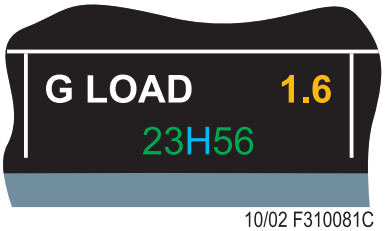
9/00 F310079C

The last two digits of the gross weight indication are dashed when accuracy is degraded.



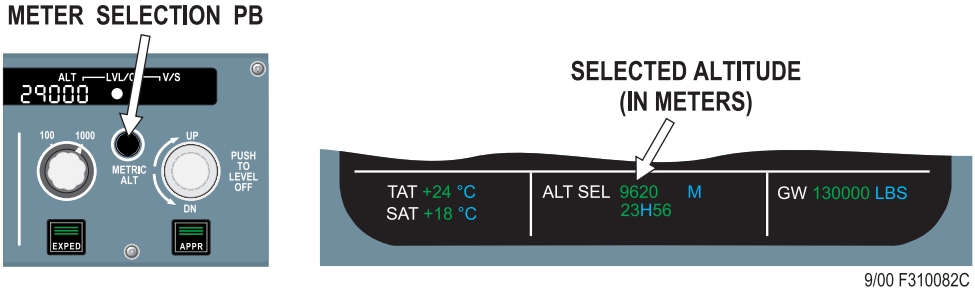
9/00 F310080C

The load factor (aircraft G) is normally not displayed. It is depicted in amber if it exceeds a predetermined value.



10/02 F310081C

If the meter selector pb on the FCU has been pressed, the message ALT SEL and the current altitude in meters is depicted in green. A second depression of this pb clears this indication.



9/00 F310082C

Status Page

Description

The STATUS page depicts a summary of the aircraft's operational status following a system malfunction and provides significant operational considerations for the approach and landing. The STATUS page is automatically displayed:

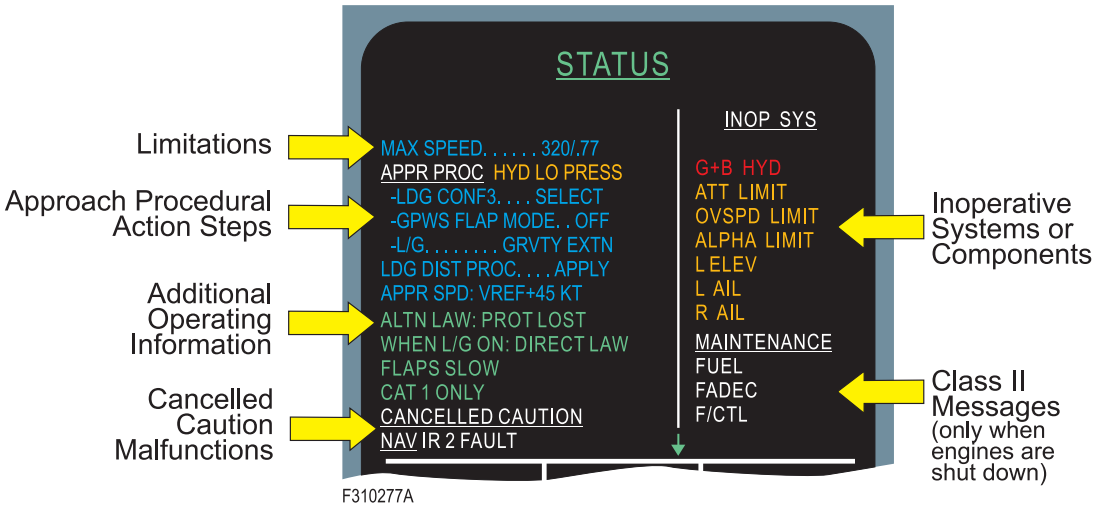
- when all monitored action steps related have been accomplished, and
- when Flaps 1 has been selected when in the approach phase (providing a malfunction is present).

The STATUS page can be displayed at anytime by pressing the STS pb on the ECAM control panel.

Status Information

The STATUS page provides the following information:

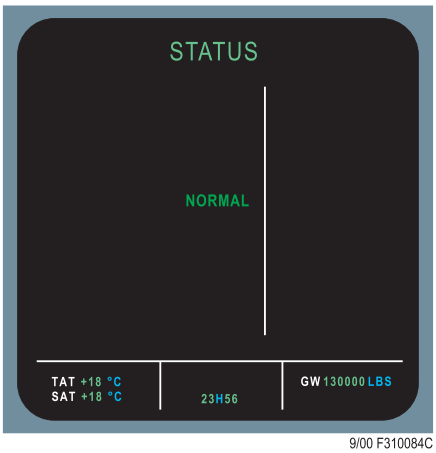
- operating limitations,
- approach procedural action steps,
- additional operating information,
- inoperative systems,
- canceled caution messages, and
- ECAM Class II messages (only when both engines are shutdown).



Status Page (continued)

Normal Status Page Display

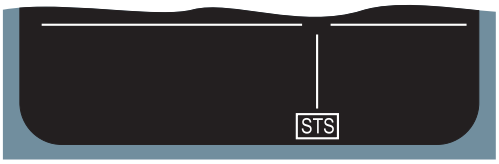
If there are no system failures or malfunctions, the word NORMAL appears in green.



9/00 F310084C

Note: With no malfunctions present, the Status page will not automatically appear when Flaps 1 is selected.

Whenever a malfunction is present, the text STS is displayed on the E/WD (Upper ECAM), as a reminder to the pilot that the Status page contains information.

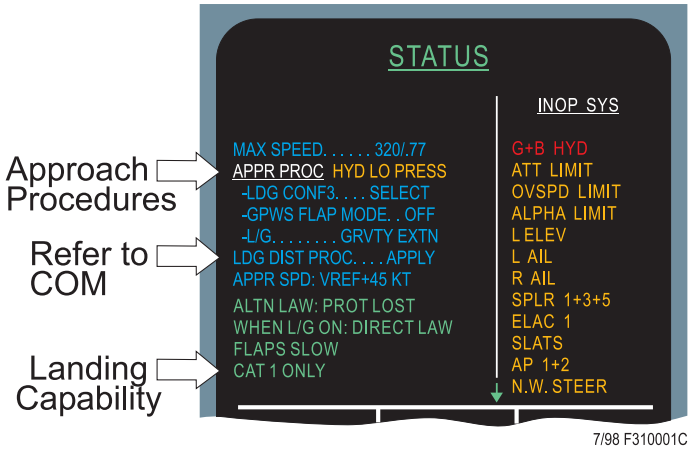


9/00 F310085C

Approach Procedures

The approach procedures depict operational considerations associated with the current malfunction/s or failures:

- limitations (airspeed, altitude) depicted in blue,
- approach procedural steps, depicted in blue,
- an indication (LDG DIST PROC.... APPLY) that the pilot should refer to the COM to determine the increase in landing distance, or
- current aircraft landing capability (if less than CAT III dual), as discussed below.



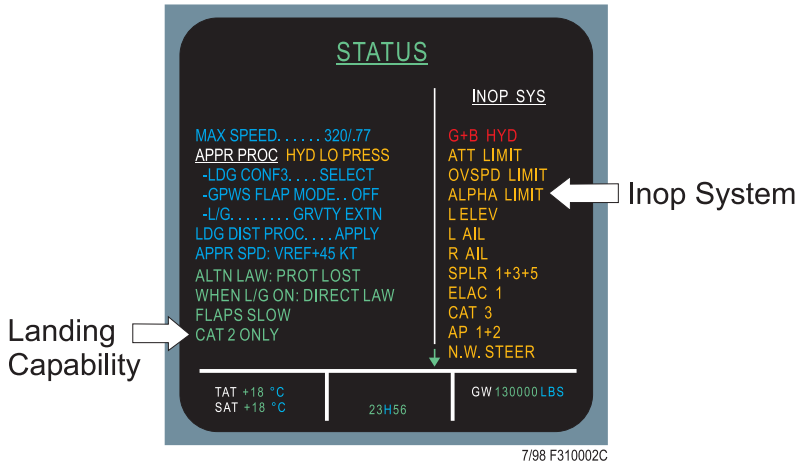
7/98 F310001C

Status Page (continued)

INOP SYS

A list of inoperative systems or components is displayed in amber. The list is not prioritized.

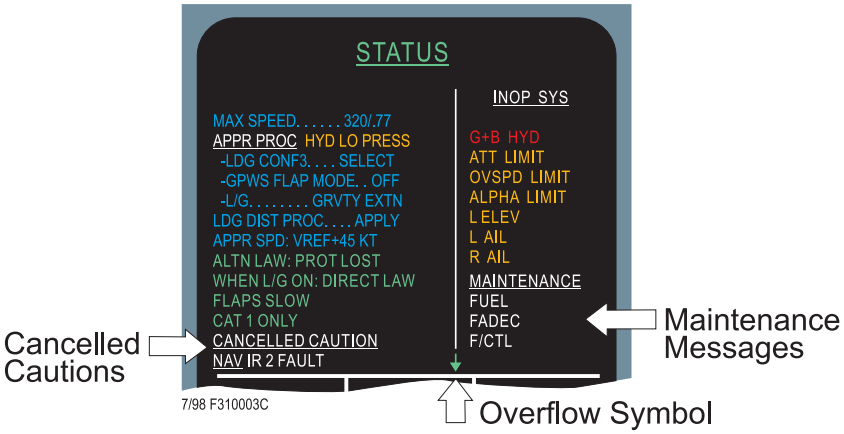
If the landing capability is degraded, that capability is listed as inoperative. For example, if the aircraft is only CAT II capable, CAT III is listed as inoperative. This allows the crew to determine the aircraft landing capability before the approach phase is initiated.



Cancelled Caution Messages

All caution messages which have been cancelled are listed on the status page.

Caution: *Cancelling a Caution failure message does not correct or resolve the condition.*



Maintenance Messages

Maintenance messages contain ECAM Class II messages, which are minor system faults that do not affect the dispatch capability of the aircraft. Class II messages are addressed in the aircraft's Minimum Equipment List (MEL).

Class II messages will only appear when both engines are shutdown.

Overflow Symbol

A green arrow appears when there is insufficient space to display all messages or checklist items on the display. Subsequent STATUS pages are accessed by using the CLR pb on the ECAM control panel.

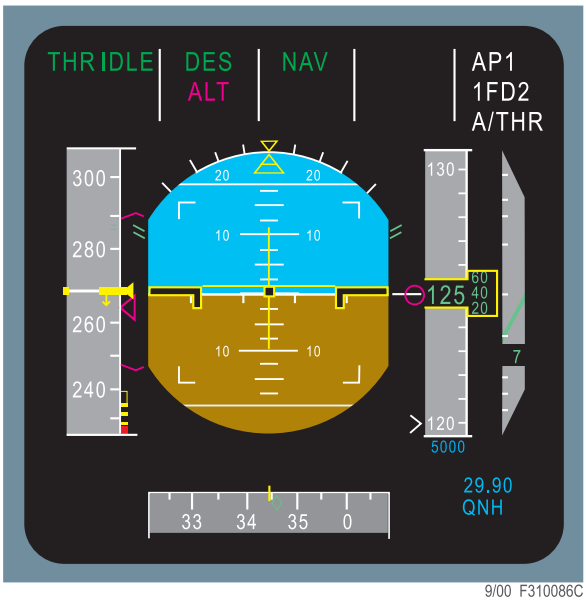
Primary Flight Display (PFD)

General

The PFD is the outer display unit on both the captain's and first officer's instrument panels. Information displayed on the PFD includes:

- attitude,
- airspeed,
- heading and/or track,
- altitude (MSL and AGL),
- vertical velocity,
- TCAS commands,
- vertical path indications,
- ILS information,
- flight mode annunciations,
- sidestick position and deflection indications, and
- ground roll guidance command bar.

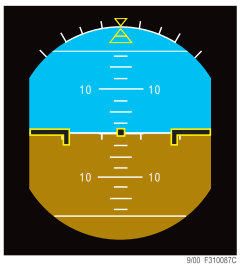
A typical PFD is shown below.



9/00 F310086C

PFD Attitude Data

PFD Attitude Indications



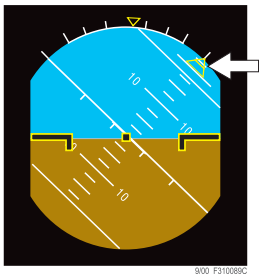
Fixed Aircraft Symbol

A fixed aircraft symbol depicts the aircraft with two simplified wings and a center box representing the center axis (nose) of the aircraft.

Bank Angle

The bank angle is depicted by a yellow triangle perpendicular to the horizon. Bank angle tic marks are provided at 10, 20, 30, and 45 degrees of bank. In the example to the right, the aircraft bank angle is 45 degrees to the left.

Note: If the aircraft bank angle is excessive, the flight directors are removed until the bank angle returns to normal.



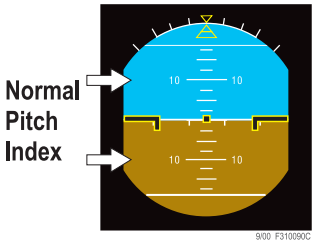
Pitch Angle

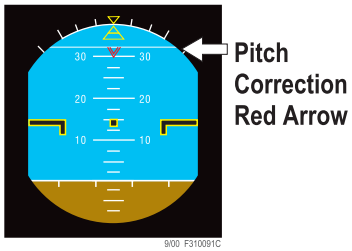
The pitch angle is depicted between 80 degrees nose up and 80 degrees nose down.

Pitch angle is depicted in 2.5 degree increments between 30 degrees nose up and 10 degrees nose down.

If the aircraft pitch angle is excessive:

- red arrows appear, pointing in the direction to achieve a normal pitch angle, and
- the flight director symbols are removed until the pitch angle returns to normal.



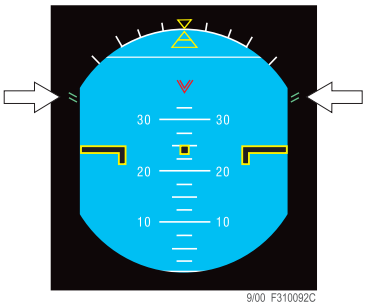


PFD Attitude Data (continued)

Attitude Protection Limits

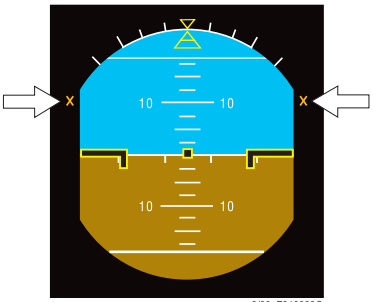
When the flight controls are in normal law (refer to chapter 27, Flight Controls), green = symbols are provided to indicate:

- the 67 degree bank angle limit,
- the maximum climb angle, and
- the maximum dive angle.



9/00 F310092C

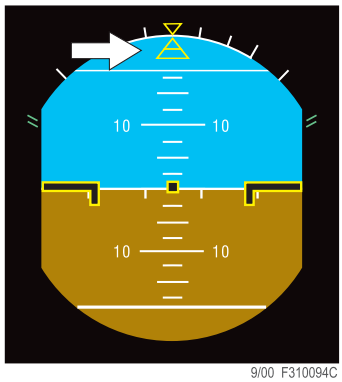
- the green = symbols are replaced with amber Xs when the corresponding protections is lost.



9/00 F310093C

Sideslip Index

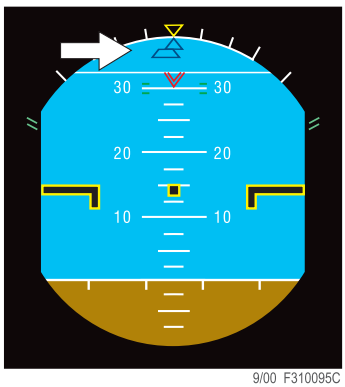
The sideslip index (SI) is located below the yellow bank angle triangle. The sideslip depicts lateral acceleration on the ground, and the sideslip (yaw) in flight.



9/00 F310094C

If an engine fails on takeoff or during a go-around, the sideslip target changes from yellow to blue. During an engine failure, the proper rudder input is indicated by the direction the sideslip is extending. In the example shown below, the pilot should increase left rudder (or left rudder trim) to reduce the sideslip.

When the sideslip is centered on the bank index, the minimum drag configuration is achieved.



9/00 F310095C

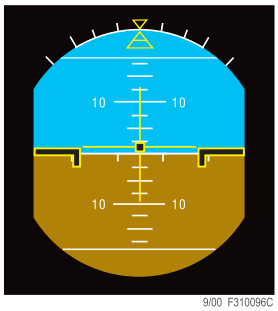
PFD Attitude Data (continued)

Flight Directors

The flight director symbols depict flight guidance commands. They are depicted on the PFD when the EFIS FD pb is illuminated.

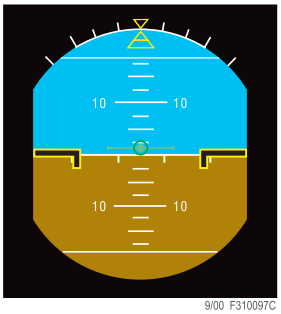
The flight director provides two modes of guidance which can be selected on the FCU. The guidance modes are:

Heading and vertical speed (HDG-V/S



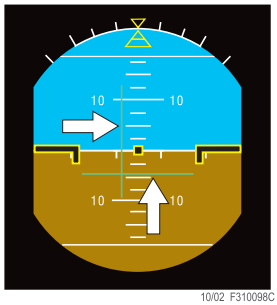
9/00 F310096C

Track and flight path angle (TRK-FPA)



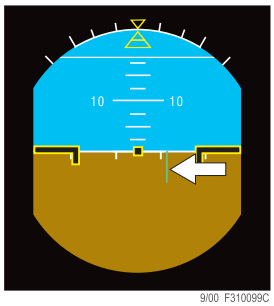
9/00 F310097C

Heading and Vertical Speed - When the flight director is on, and the HDG-V/S mode is selected, pitch and roll command bars are depicted in green on the PFD. The pitch command bar provides guidance to the active vertical guidance mode. The roll command bar provides guidance to the active lateral guidance mode. In the example, a descending left turn is commanded.



10/02 F310098C

Note: On the ground, during takeoff and landing, the roll command bar is replaced by a ground roll guidance command bar when an ILS frequency and course are tuned. The pitch command bar is removed when the aircraft is on the ground.



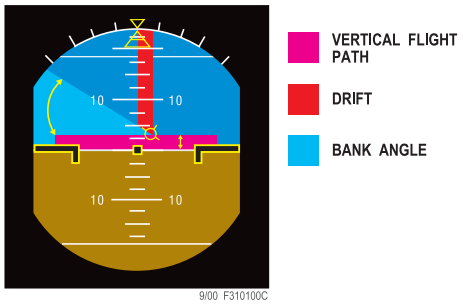
9/00 F310099C

PFD Attitude Data (continued)

Flight Directors (continued)

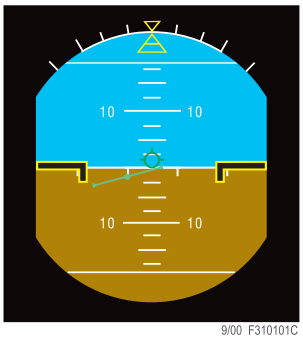
Track and Flight Path Angle - When the TRK-FPA guidance mode is selected, the FPA symbol is depicted in green on the PFD. This symbol is an idealized symbol representing the aircraft's flight path as seen from behind. The FPA represents the aircraft's velocity vectors in space. It depicts the:

- vertical flight path relative to the horizon,
- drift angle relative to the aircraft's heading, and
- bank angle.



When the flight director pb is selected on, the command bar is depicted in green. This command bar (mustache) simultaneously commands pitch and roll to the active vertical and lateral flight guidance modes. In the example below, a descending left turn is commanded.

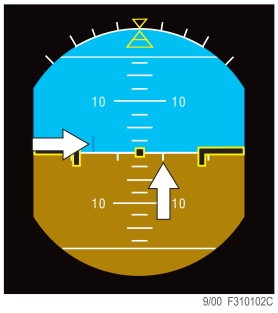
Note: Refer to chapter 22, Autoflight, for a more detailed discussion of the flight director system.



Heading Reference

Heading graduations in 10 degree increments are displayed, in white, below the horizon line.

When the flight director is selected off, the FCU selected heading or track is depicted by a vertical blue line on the horizon.

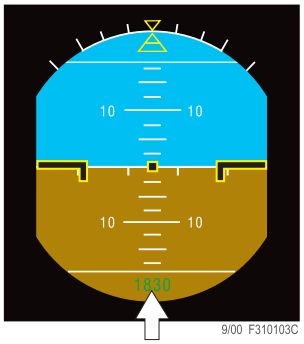


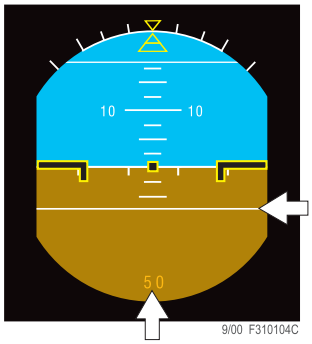
PFD Attitude Data (continued)

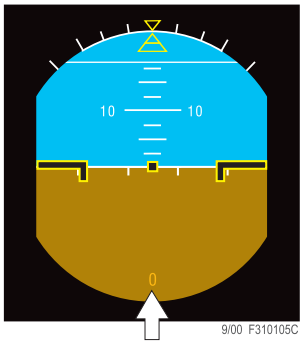
Radio Altitude

At low altitudes, the aircraft radio height is depicted in green in the lower portion of the attitude indicator.

Below a predetermined radio height, a white line at the bottom of the attitude indicator is displayed to represent the ground. This line gradually rises, as the radio height decreases, until it meets the horizon line at touchdown.

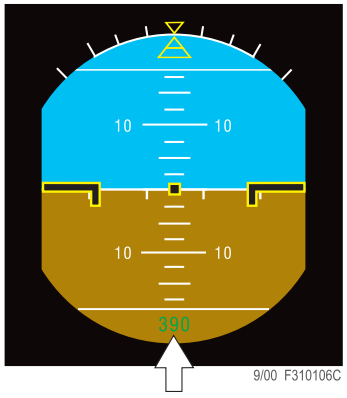




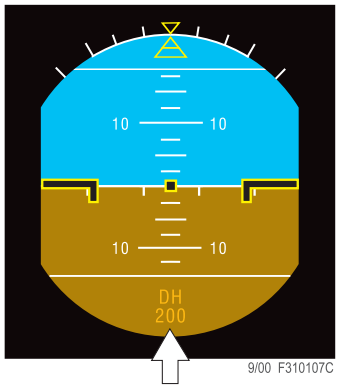


The digital radio height indication becomes larger as the aircraft nears the ground. It becomes amber at:

- the MCDU entered decision height (DH) if entered, and
- at 400 feet AGL, if a DH was not entered.

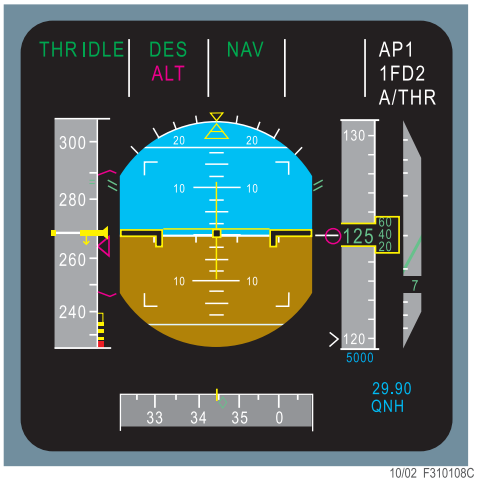


Note: When a DH is entered (in the MCDU), and the aircraft descends below the DH, the letters DH appear in amber above the digital height and flash for a short period.



PFD Airspeed Indications

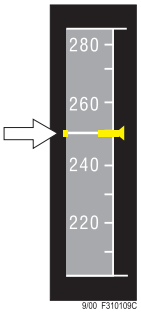
PFD Airspeed Indications



10/02 F310108C

Indicated Airspeed

The indicated airspeed (IAS) is depicted by a yellow index line which extends horizontally across the airspeed scale.

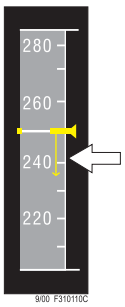


9/00 F310109C

Trend Arrow

The IAS trend arrow:

- is depicted on the airspeed scale extending from the IAS index line, and
- identifies the airspeed the aircraft will attain in 10 seconds if the present acceleration or deceleration remains constant.



9/00 F310110C

The trend arrow is not depicted when the airspeed is stabilized. Uses of the trend arrow include:

- autothrust speed control trends,
- an indication of the required engine thrust when manually controlling thrust,
- an indication of turbulence or mountain wave activity during cruise, and
- an indication of windshear during takeoff or approach.

PFD Airspeed Indications (continued)

Target Airspeed

The target airspeed is depicted on the airspeed scale by a triangle which is selected:

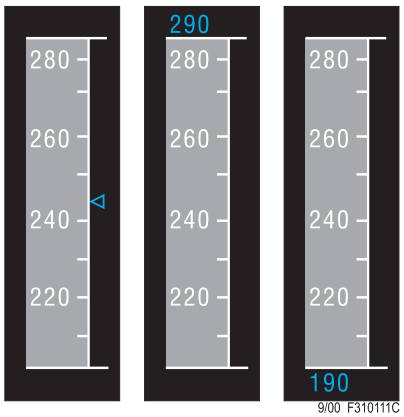
- manually by the pilot using the flight control unit speed (SPD)/MACH knob (selected speeds), or
- automatically by the FMGC (managed speeds).

For a detailed discussion of selected and managed speeds, refer to chapter 22, Autoflight.

Target Airspeeds/ Selected Speeds

The target airspeed is depicted by a:

- blue triangle when the selected airspeed is within the display range of the airspeed scale,
- digital indication in blue at the top of the airspeed scale when the selected speed is higher than the top of the airspeed scale, and
- digital indication in blue at the bottom of the airspeed scale when the selected speed is lower than the bottom of the airspeed scale.



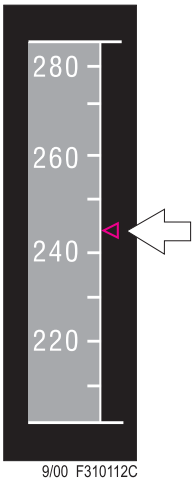
The digital indication corresponds to IAS or MACH, as selected on the FCU.

Target Airspeeds/ Managed Speeds

The target airspeed is depicted by a:

- magenta triangle when the managed airspeed is within the display range of the airspeed scale,
- digital indication in magenta at the top of the airspeed scale when the managed speed is higher than the top of the airspeed scale, or
- digital indications in magenta at the bottom of the airspeed scale when the managed speed is lower than the bottom of the scale.

Note: In certain circumstances, managed speeds can also be depicted by the maneuvering speed or best lift to drag speed (discussed later).



PFD Airspeed Indications (continued)

Mach Number

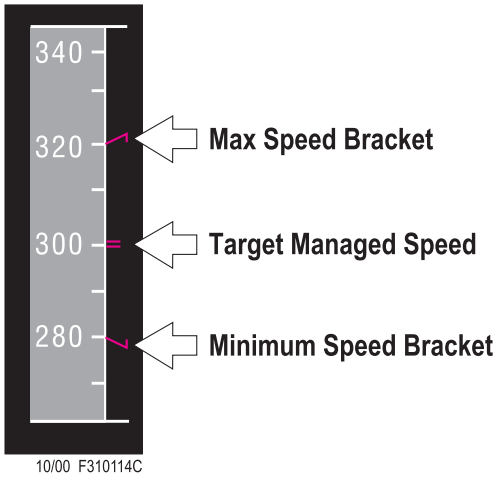
The current Mach number is depicted, in green, below the airspeed scale when the aircraft speed is greater than 0.5 Mach.

Managed Descent Speed Range

When operating in the managed descent (DES) flight guidance mode, and in managed speed, the airspeed may vary to maintain the desired descent path. Allowable airspeed variations are up to ± 20 knots. The allowable airspeed variations are reduced by:

- flight plan speed limits and speed constraints,
- maximum operating speeds (for example a flap limit speed), and
- minimum operating speeds (for example Vls).

The allowable speed range is depicted on the airspeed scale as two magenta brackets. The managed speed is depicted by a magenta "=" which replaces the magenta triangle.

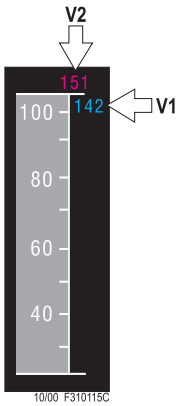


PFD Airspeed Indications (continued)

Takeoff V Speeds

Takeoff performance airspeeds are manually inserted via the MCDU prior to takeoff. They are identified as V_1, V_R, and V_2.

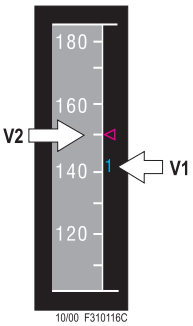
Prior to takeoff roll, V_1 and V_2 are depicted digitally at the top of the airspeed scale.



When the V_1 and V_2 speed range is in view on the airspeed scale:

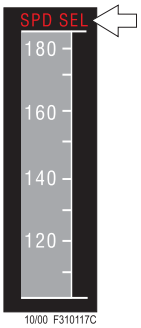
- V_1 is depicted as a blue 1, and
- V_2 is depicted as a magenta triangle.

Note: Although V_R is entered in the MCDU, it is not depicted on the airspeed scale.



If the pilot forgets to enter takeoff V speeds, or if the speeds have been dropped by the FMGC, a red “SPD SEL” flag is displayed at the top of the airspeed scale.

Note: If V_2 is not inserted, the speed reference system (SRS) will not engage on takeoff.



Warning

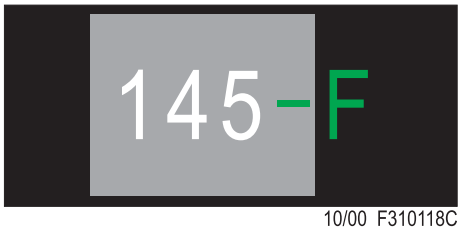
With both flight directors off, V_2 indications default to 100 knots. This abnormal condition could result in an unsafe takeoff speed if it is not recognized.

PFD Airspeed Indications (continued)

Takeoff F and S Speed Indications

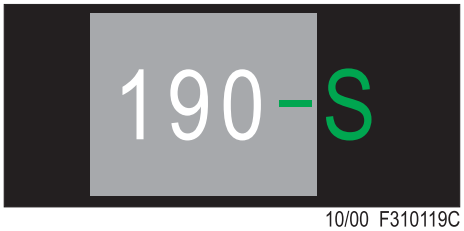
The minimum airspeed for retracting the slats/flaps after takeoff or during a go-around is depicted by:

- the symbol F, in green, for flap position 3 and 2, and



10/00 F310118C

- the symbol S, in green, for flap position 1.



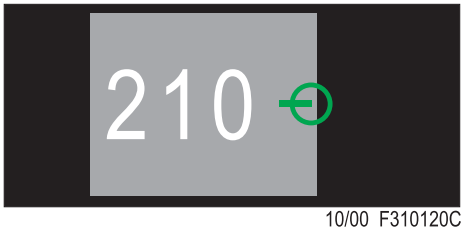
10/00 F310119C

Green Dot Airspeed

The maneuvering (minimum) airspeed in the clean configuration is depicted by a green dot on the airspeed scale.

Green dot speed is also:

- the best rate of climb speed (single engine conditions),
- the minimum angle of descent speed,
- the managed speed in expedite climb (EXP CLB) flight guidance mode (refer to chapter 22, Autoflight),
- the managed speed in the clean configuration during the FMS approach (APPR) phase (refer to chapter 34, Navigation), and
- the managed speed following an engine failure (when the aircraft is climbing).



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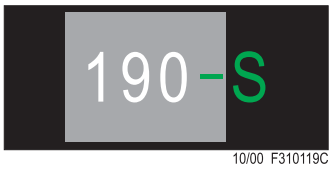
PFD Airspeed Indications (continued)

Slats/Flaps Extended Maneuvering Speeds

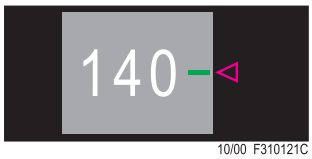
The managed speed in the FMS APPR phase is the maneuvering speed appropriate to the selected slat/flap configuration (refer to chapter 22, Autoflight). The maneuvering (minimum) airspeed for slats/flaps extended is depicted by:

- the green symbol S for flap position 1,



- the green symbol F for flap positions 2 and 3, and

- a magenta triangle for flap position FULL. This symbol represents approach speed (V_{APP}).



VAPP

In managed speed, V_{APP} is depicted as a magenta triangle in all flap configurations when operating in the FMS APPR phase. When V_{APP} is outside the display range, it is displayed digitally at the bottom of the airspeed scale.

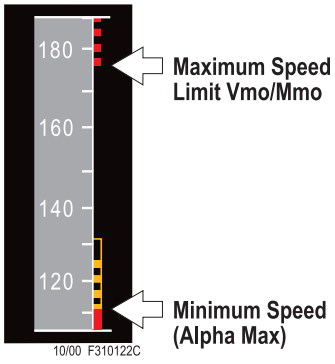
In selected speed:

- V_{APP} is not displayed, and
- the selected speed is displayed as a blue triangle.

Airspeed Limits

The airspeed scale depicts airspeed limitations for both maximum and minimum operating airspeeds.

These airspeed limitations are computed by the Flight Augmentation Computers (FACs) and are computed for the selected aircraft configuration (i.e., gear, slats/flaps, speed brakes).



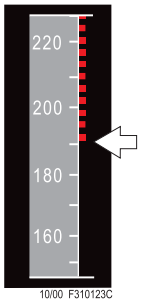
PFD Airspeed Indications (continued)

Maximum Operating Airspeeds

The maximum operating airspeed is depicted by the lower end of a red and black strip which extends from the top of the airspeed scale.

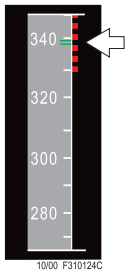
The maximum operating airspeed indication moves to represent the slowest of the following maximum allowable airspeeds:

- maximum allowable airspeed (Vmo or Mmo),
- maximum allowable airspeed with the landing gear extended (V_{MAX}), and
- maximum allowable airspeed for the current slat/flap setting (V_{MAX}).

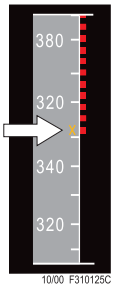


Overspeed Protection

A green = symbol is depicted adjacent to the Vmo/Mmo indication to identify the speed at which overspeed protection becomes active (refer to chapter 27, Flight Controls)



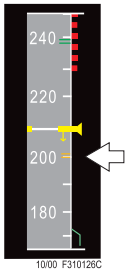
An amber X is depicted adjacent to the Vmo/Mmo indication to indicate that overspeed protection is not available. This occurs when the flight controls are no longer in normal law (refer to chapter 27, Flight Controls).



Maximum Airspeed for Flap Extension

The maximum airspeed at which the next higher flap setting can be selected is depicted by an amber = symbol on the airspeed scale.

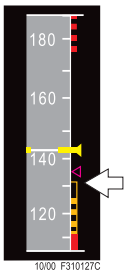
For example, if the flaps are currently at the FLAPS 1 setting, the maximum speed for extension of the flaps to 2 is depicted by an amber =.



PFD Airspeed Indications (continued)

Minimum Selectable Airspeed

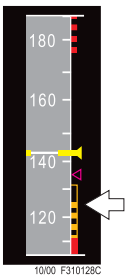
The minimum selectable airspeed (V_{LS}) is depicted by the top of an amber strip along the airspeed scale (refer to chapter 22, Autothrust).



Alpha Protection Airspeed

The Alpha protection (angle of attack protection) airspeed is depicted by the top of an amber and black strip along the airspeed scale.

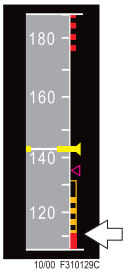
Note: Alpha protection is only depicted in normal flight control law (refer to chapter 27, Flight Controls).



Alpha Maximum Airspeed

Alpha maximum (maximum angle of attack) airspeed is depicted by the top of a solid red strip along the airspeed scale.

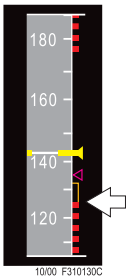
Note: Alpha maximum is only depicted in normal flight control law (refer to chapter 27, Flight Controls).



Stall Warning Airspeed

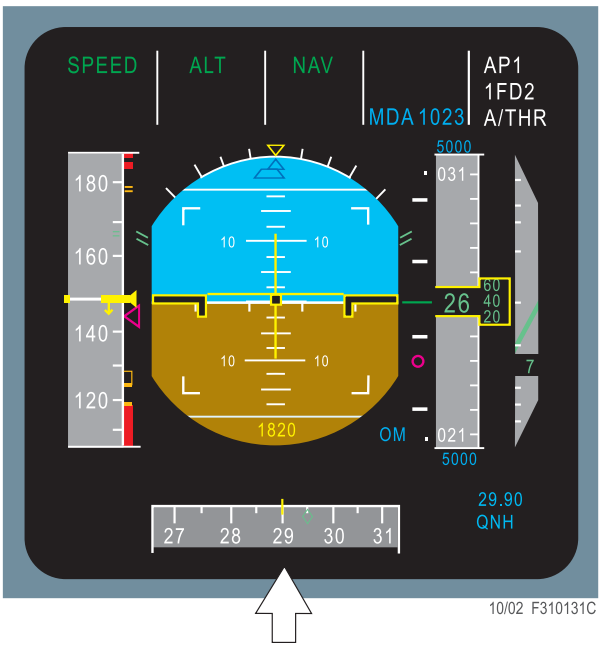
Stall warning airspeed is depicted by the top of a red and black strip along the airspeed scale.

The stall warning airspeed indication replaces the alpha protection and alpha maximum indications when the flight controls are not in normal law (refer to chapter 27, Flight Controls).



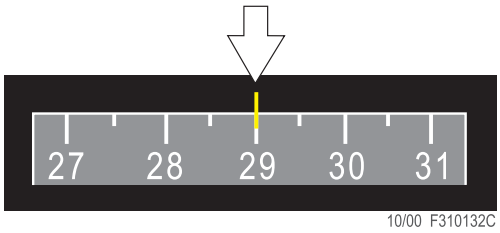
PFD Heading Indications

PFD Heading Indications



Current Heading

The current heading is depicted by a yellow index line located on the center of the heading scale.

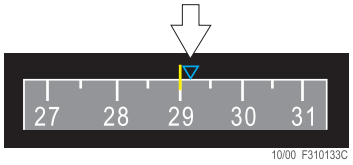


PFD Heading Indications (continued)

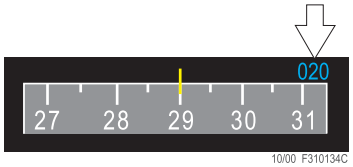
Selected Heading (or Track)

The FCU selected heading (or track) is depicted by:

- a blue triangle when the selected heading (or track) is within the heading scale display range.



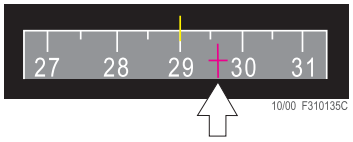
- a blue digital indication when the selected heading (or track) is outside the heading scale display range.



ILS Inbound Course

The ILS or localizer inbound (front) course is depicted by:

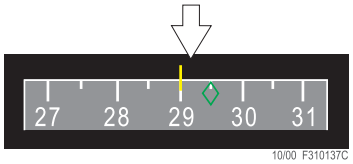
- a magenta dagger when the inbound course is within the heading scale display range.



- a magenta digital indication when the inbound course is outside the heading scale display range.

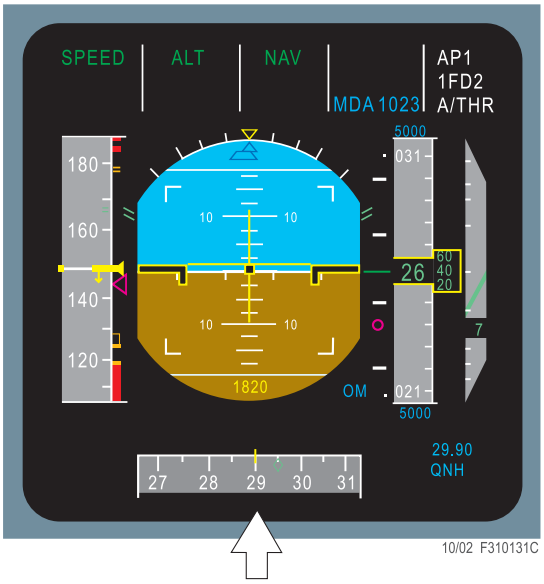
Current Ground Track

The current aircraft ground track is depicted by a green diamond on the heading scale



PFD Altitude Indications

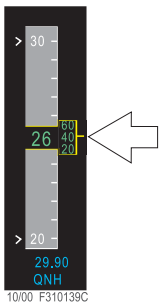
PFD Altitude Indications



Current Altitude

A yellow altitude window in the center of altitude scale identifies the present aircraft altitude.

The current aircraft altitude is depicted by a green digital indication within the altitude window.

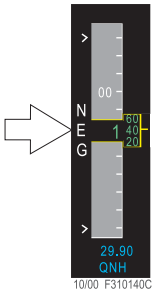


Current Altitude

The message NEG is depicted in white adjacent to the altitude window for altitudes below mean sea level.

The current altitude pulses in amber when the aircraft:

- has deviated significantly from the FCU selected altitude (refer to Altitude Warning, this chapter), or
- the aircraft has descended below the MDA during and instrument approach (refer to approach minimums alert, this section).

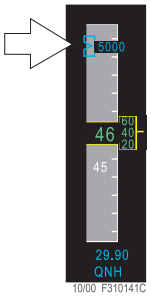


PFD Altitude Indications (continued)

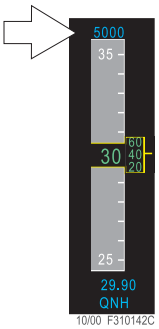
Selected Altitude

The FCU selected altitude is depicted as:

- a blue box when the selected altitude is within the altitude scale display range.



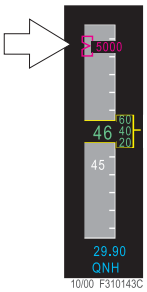
- a blue digital indication at the top or bottom of the altitude scale (as appropriate), when the selected altitude is outside the altitude scale display range.



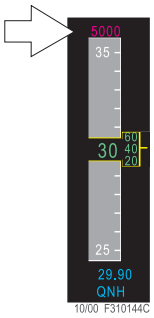
Constraint Altitude

When the active vertical flight guidance mode is a managed mode (i.e., CLB or DES), and there is a constraint altitude in the flight plan which is not the same as the selected FCU altitude, the altitude constraint is depicted as:

- a magenta box when the selected altitude is within the altitude scale display range, or



- a magenta digital indication at the top or bottom of the altitude scale (as appropriate), when the selected altitude is outside the altitude scale display range.

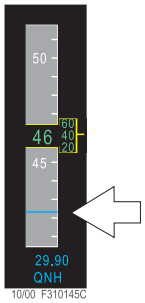


Note: If the aircraft will not level off at the constraint, only the blue FCU altitudes are displayed.

PFD Altitude Indications (continued)

Landing Field Elevation

When the landing field elevation is within the altitude scale display range, it is depicted by a horizontal blue line which extends across the scale.



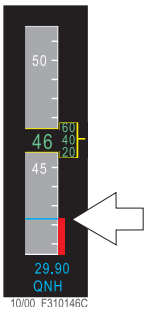
Note: The landing field elevation indication is based on pilot selected barometric altimeter setting, and the FMGC data base elevation for the selected destination airport and runway.

Ground Reference Elevation

The ground reference elevation is depicted by a red vertical line which appears on the altitude scale when the ground reference elevation is within the altitude scale display range.

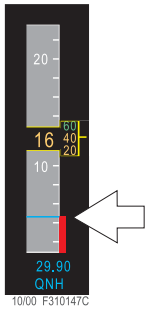
The red vertical line reaches the middle of the altitude window at touchdown.

Note: The ground reference elevation is based on the radio altimeter.



Approach Minimums Alert

If the pilot has entered an approach MDA via the MCDU, then the current aircraft altitude indication turns amber and flashes when the aircraft descends below the MDA.



PFD Altitude Indications (continued)

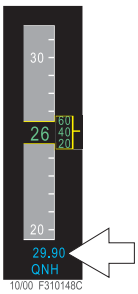
Barometric Altimeter Reference

The barometric altimeter setting for the altitude scale is set by using the EFIS barometric reference selector knob. It is set in:

- inches of mercury (in Hg), or
- Hectopascals (hPa).

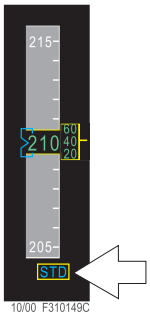
The altimeter setting is depicted on the PFD by:

- a blue digital indication below the altitude scale when the EFIS barometric reference selector knob has been pushed and turned to the desired setting, or



10/00 F310148C

- the blue message STD (standard) surrounded by a yellow box when the EFIS barometric reference selector knob has been pulled. The message STD indicates that the altimeter scale is using a standard altimeter reference (29.92 in Hg or 1013 hPa as appropriate).



10/00 F310149C

Note: The EFIS barometric reference selector knob must be pulled when the aircraft climbs above the transition level or the altimeter setting will flash. Manually setting the barometric reference to standard will not terminate the flashing reference.

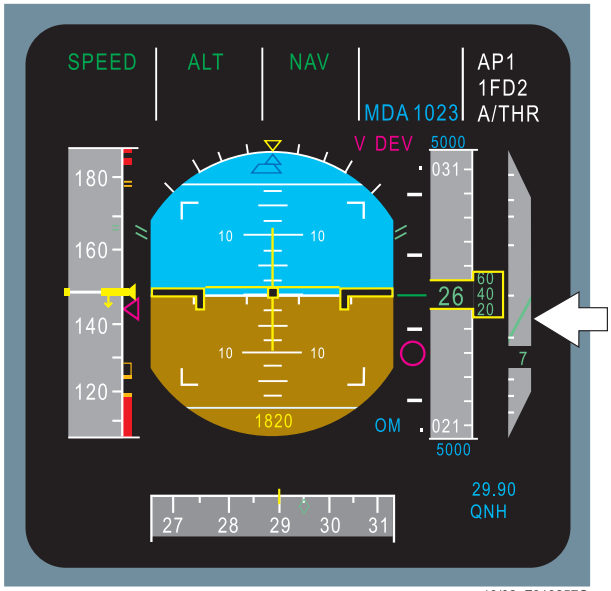
The message STD flashes when the aircraft is below the transition level and a digital altimeter setting has not been selected.

10/00 F310150C

Caution: *Changing baro settings during ALT Capture (ALT *) may result in a failure of the Auto Flight system to capture the altitude.*

PFD Vertical Speed Indications

PFD Vertical Speed Indications



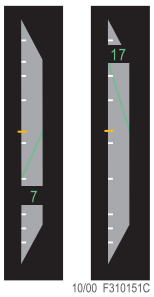
10/02 F310257C

Normal Indications

Aircraft vertical speed is normally depicted by:

- a green needle on the scale, or
- a green digital indication at the end of the needle.

The digital indication represents vertical speed in hundreds of feet per minute.



10/00 F310151C

Excessive Vertical Speed Advisory Indication

Both the needle and the digital vertical speed indications are displayed in amber when the rate of climb or descent exceeds preset limits. These preset limits vary in different phases of flight. An amber depiction indicates that a vertical speed limit has been exceeded.

10/00 F310152C

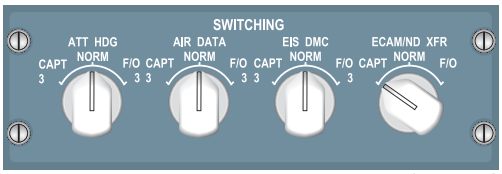
PFD Vertical Speed Indications (continued)

Backup Vertical Speed Information

If the IRU vertical speed signal is not available, the ADR automatically provides a barometric backup signal. This condition is indicated by an amber box on the vertical speed scale around the digital indication. The barometric ADR signal is less stable than the inertial vertical velocity and will lag the actual value during rapid changes.

10/00 F310153C

During an IRU failure, IRU vertical speed information (e.g., IRU 3) can be regained by selecting the ATT HDG knob on the switching panel to CAPT 3 or FO 3.



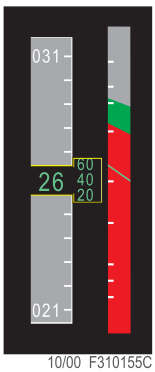
8/00 F310054C

TCAS Vertical Commands

The TCAS commands vertical maneuvers to maintain or increase separation from TCAS intruder traffic. These vertical commands are depicted on the vertical speed scale as:

- green areas, to indicate required climb or descent rates, and
- red areas, to indicate prohibited climb or descent rates.

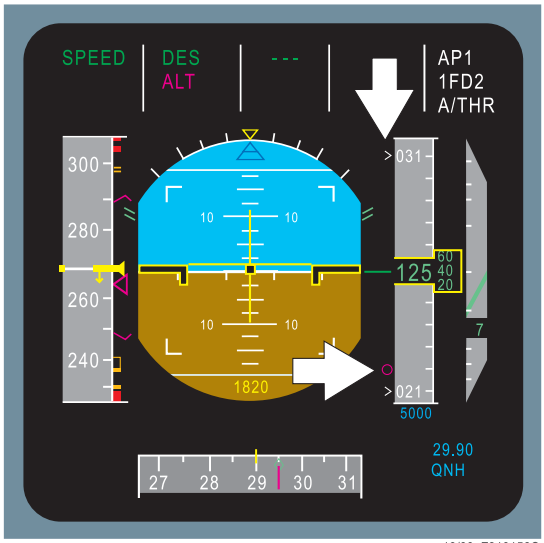
Note: Refer to chapter 85, Warning Systems, for a complete discussion of TCAS.



10/00 F310155C

PFD Vertical Guidance Indications

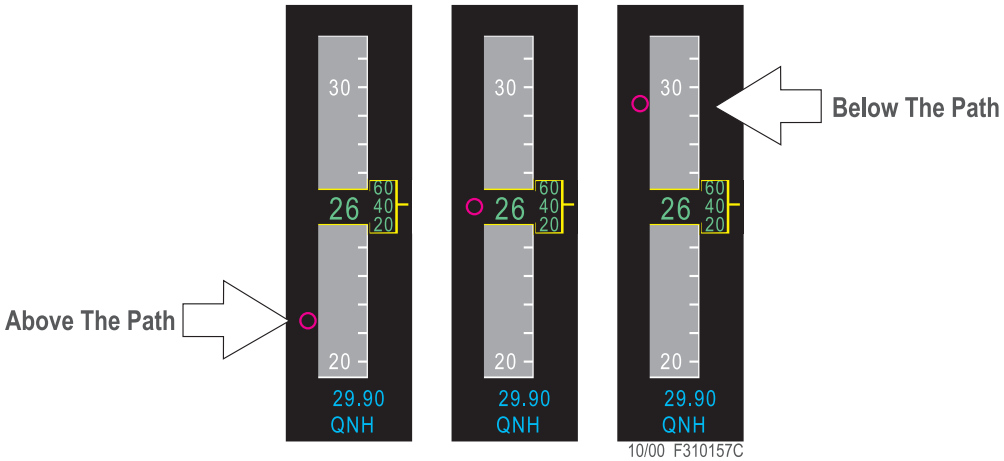
Vertical Guidance Indications



10/00 F310156C

Descent Path Indicator

The descent path indicator is automatically displayed during the FMS descent and approach phases (refer to chapter 34). The indicator displays the aircraft's vertical relationship to the computed descent path. If the path indicator is even with the current altitude, the aircraft is exactly on the computed path. The examples shown below illustrate positions above and below the computed descent path.



10/00 F310157C

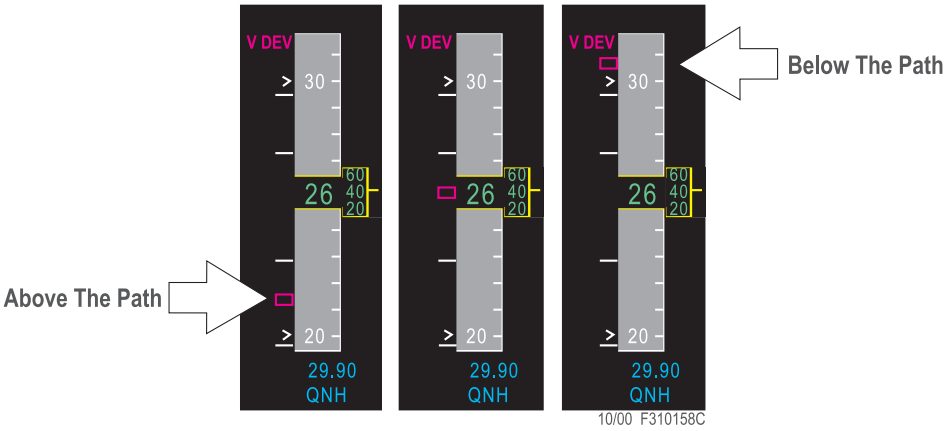
The descent path indicator disappears when either:

- the vertical deviation indicator (VDEV) is displayed (discussed later), or
- the ILS glide slope indicator is displayed and G/S* or G/S mode is engaged.

PFD Vertical Guidance Indications (continued)

Vertical Deviation (VDEV) Indicator

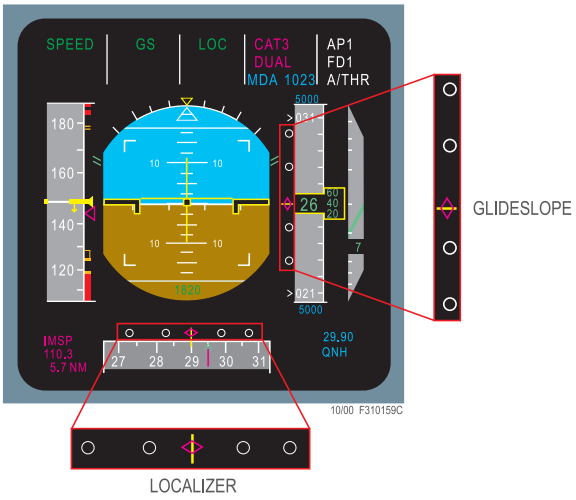
The VDEV indicator is displayed when the FCU APPR pb is armed and a data base non-precision approach has been entered into the flight plan. The VDEV indicator is similar to a glide slope indicator and indicates the aircraft's vertical relationship to the computed descent path for the approach (refer to chapter 34, Navigation). If the VDEV indicator is even with the current altitude, the aircraft is exactly on the computed path. Each tic mark represents 100 feet altitude deviation. The examples shown below illustrate positions above, on, and below the computed descent path:



Note: The ILS glide slope indication has priority over the VDEV indicator.

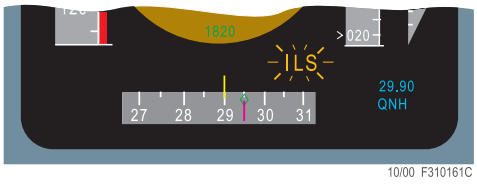
PFD ILS Indications

ILS Indications



ILS Message

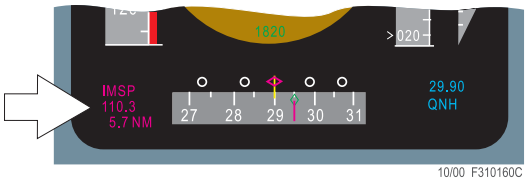
If the pilot forgets to select the EFIS ILS pb, an ILS frequency has been tuned, and the FCU APPR pb has been armed, a flashing amber “ILS” message is displayed on the PFD. This reminds the pilot to display the ILS information on the PFD.



ILS Information

When the ILS deviation scales are displayed, the following ILS information is depicted in the lower left corner of the PFD:

- ILS identification,
- ILS frequency
- DME distance (when an associated ILS DME is available)



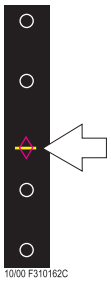
Note: Display of the ILS identification indicates that a valid identification signal is being received.

PFD ILS Indications (continued)

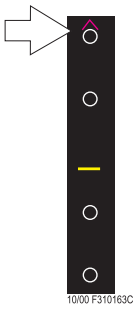
Glide Slope and LOC Indications

Deviation from the glide slope and LOC is depicted by:

- A magenta diamond when the aircraft is within two dots of the glide slope, or



- a magenta half diamond when the aircraft is outside two dots (full scale deflection) of the glide slope and LOC.



Note: The magenta diamond (or half diamond) only appears when the glide slope is being received.

The scale for both the glide slope or LOC flash when preset deviation limits are reached. The parameter of these limits become tighter as the aircraft gets closer to the airport.

Advisory Indication

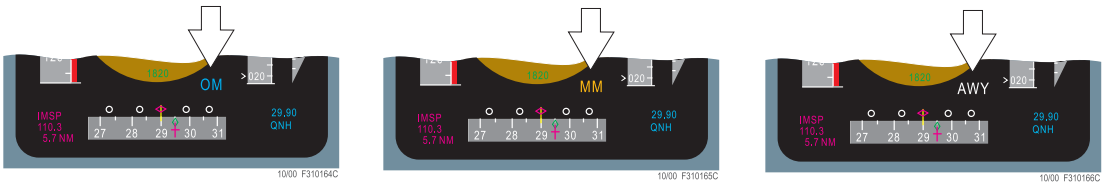
The glide slope deviation scale and indicator flash when there is excessive deviation from the glide slope.

Marker Beacons

Marker beacon indications appear on the PFD when the marker beacon signal is being received. These indications are:

- a flashing blue OM to indicate the outer marker,
- a flashing amber MM to indicate the middle marker, or
- a flashing white AWY to indicate the inner marker.

An example is shown below.

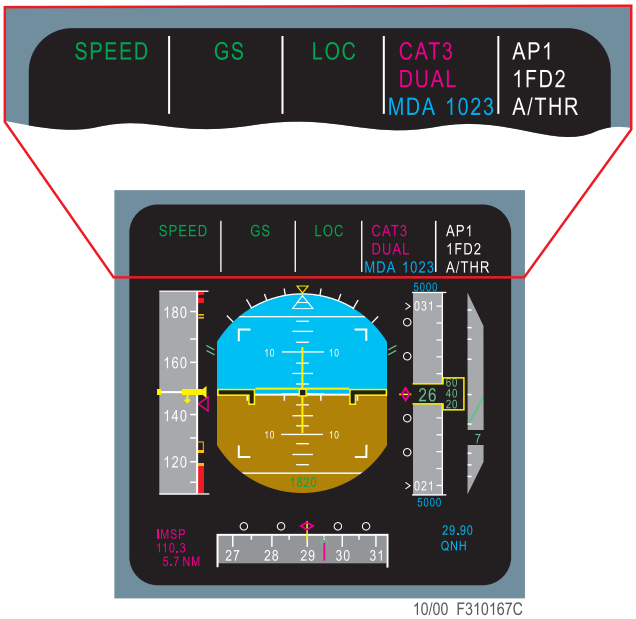


Note: The PFD marker beacon indications are independent of the EFIS ILS pb and the ACP marker beacon audio pb.

PFD Flight Mode Annunciator (FMA) Indications

Description

The flight mode annunciator (FMA) is located at the top of the PFD. Flight mode annunciations allow the pilot to confirm engaged flight guidance modes, autopilot, flight director, and autothrust status, as well as monitor approach capabilities. The FMA is discussed in detail in chapter 22, Autoflight.



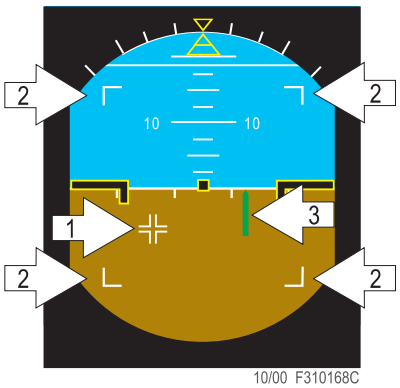
10/00 F310167C

PFD Specific Indications on the Ground

PFD On Ground

Sidestick Positions

This sidestick position (1) indication is displayed on the ground after the first engine start. It s white in color. It indicates the combined captain and first officer sidestick position.



10/00 F310168C

Maximum Sidestick Deflection

The maximum sidestick deflection, represented by four white corners (2), is displayed on the ground after the first engne start.

Ground Roll Guidance Command Bar

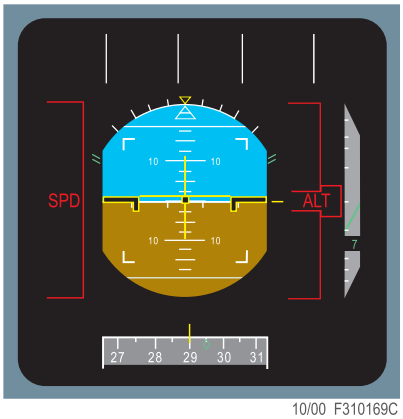
The ground roll guidance command bar (3) is displayed on the ground, in green. The indication moves left or right to indicate the aircraft's position from the runway center line. A localizer signal is required for this display to appear.

PFD Warning Flags and Messages

Red Flags

Red warning flags are displayed on the PFD to indicate failed components. The warning flag is displayed in the same location on the PFD as the component that failed. A corresponding ECAM message describes the proper corrective procedure (discussed later).

In the example below, the ADR has failed, causing the loss of the airspeed (SPD) indicator and the altimeter (ALT). A complete list of warning flags is provided later in this section.

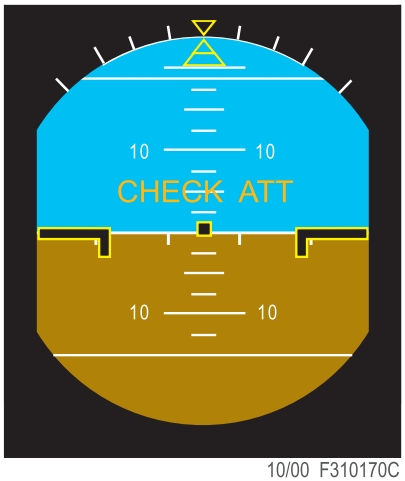


10/00 F310169C

Amber Messages

Amber messages are depicted on the PFD when a discrepancy has been detected between the captain's and first officer's PFDs.

In the example below, the message CHECK ATT indicates that a difference has been detected between the two attitude indicators.



10/00 F310170C

Navigation Display (ND)

General

The navigation display (ND) is located inboard of each PFD on the instrument panel. Each ND is controlled independently.

Navigation information can be depicted on the ND in 5 different modes. The modes are selected with the EFIS control panel. The modes are ROSE ILS, ROSE VOR, ROSE NAV, ARC, and PLAN.

ROSE VOR

10/00 F310171C

ROSE ILS

10/00 F310172C

ROSE NAV

10/00 F310173C

ARC

10/00 F310178C

PLAN

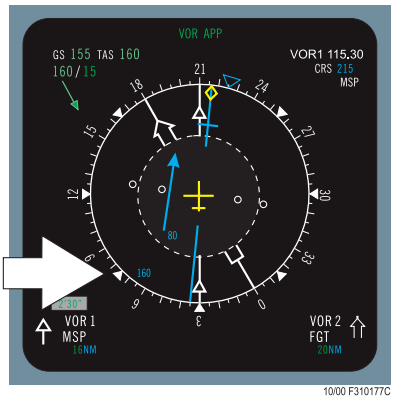
10/00 F310174C

Navigation Display (ND) (continued)

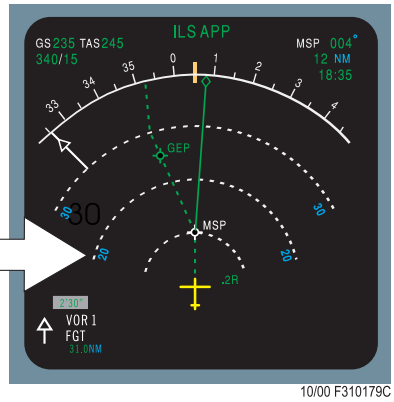
Range Scales

The ND range scale is selected with the EFIS ND range selector.

In the ND ROSE modes, the range scales are depicted by a white dashed circle with range markers adjacent to the circles. The maximum range circle is half the distance selected on the EFIS range selector.



In the ND ARC mode, the range scales are depicted by white dashed arcs with range markers adjacent to the arcs. The maximum range of the arc is equal to the range selected on the EFIS range selector.



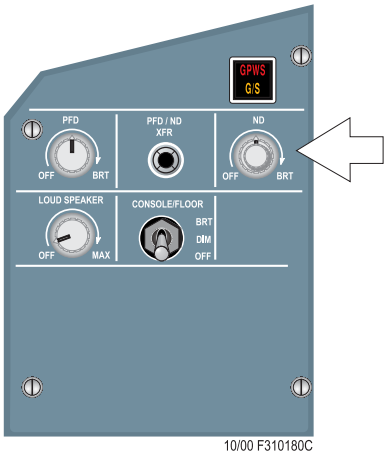
Navigation Display (ND) (continued)

Weather Radar Display

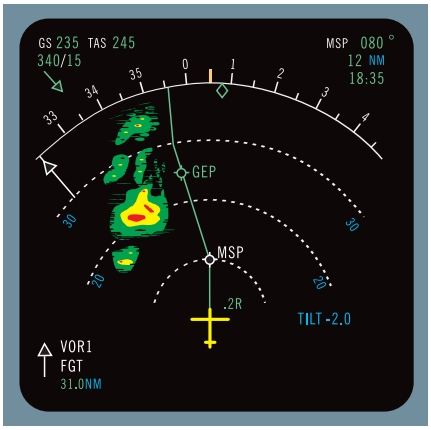
The weather radar image is displayed on the ND in all modes except PLAN. Each ND can display a different range, if desired.

The radar display intensity is controlled with the outer knob of the EFIS ND control.

Refer to chapter 34, Navigation, for a detailed discussion of the weather radar.



10/00 F310180C



10/00 F310181C

TCAS Display

Traffic information from the traffic alert and collision avoidance system (TCAS) is displayed on the ND at ranges of 40 nm and less. It is available in all modes except PLAN.

Refer to chapter 85, Warning Systems, for a detailed discussion of the TCAS system.

10/00 F310182C

ND Mode Common Information

Overview

Certain information can be displayed in all ND map modes (ROSE NAV, ARC, and PLAN). This information is:

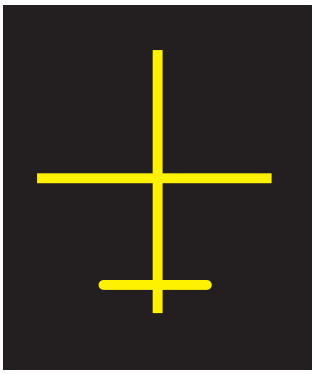
- the aircraft position symbol,
- the aircraft heading,
- the selected heading (or track),
- the current ground track,
- ground speed,
- true airspeed,
- wind direction and speed,
- the selected navaid information,
- the TO waypoint bearing, range, and ETA,
- the selected approach, and
- the chronometer display

10/00 F310183C

ND Mode Common Information (continued)

Aircraft Position Symbol

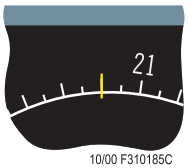
The aircraft position symbol is depicted by a yellow fixed aircraft symbol and points “up” to the aircraft heading indicator.



10/00 F310184C

Magnetic Heading

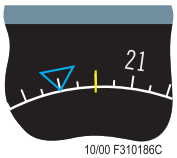
The magnetic heading is depicted by a fixed yellow index in front of a moving white heading scale.



10/00 F310185C

Selected Heading (or Track)

The FCU selected heading (or track) is depicted by a blue triangle on the heading scale.

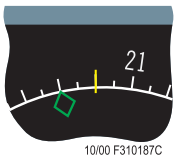


10/00 F310186C

Ground Track

The current ground track is depicted by a green diamond on the heading scale.

When the aircraft is flying on a selected heading (or track), a solid green line extends from the aircraft symbol to the heading scale, indicating the projected aircraft track on the current aircraft heading.

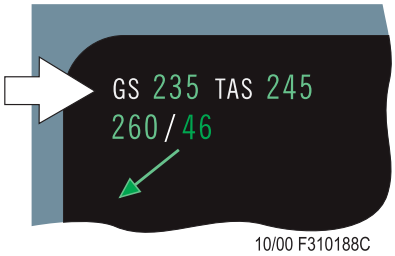


10/00 F310187C

ND Mode Common Information (continued)

Ground Speed

The ground speed (GS) is depicted in knots by a green digital indication.

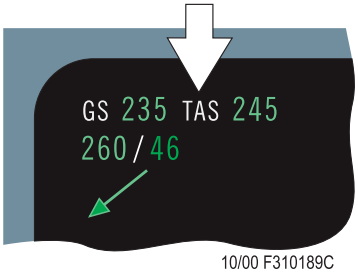


10/00 F310188C

Note: The ground speed is also depicted on the ground.

True Airspeed

The true airspeed (TAS) is depicted in knots by a green digital indication.



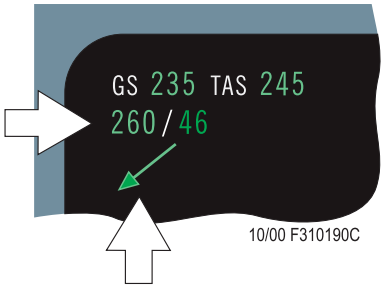
10/00 F310189C

Wind Direction and Speed

The wind direction is depicted by:

- a green digital indication displaying true wind direction, and
- a green arrow showing the magnetic wind relative to the aircraft heading.

Wind speed, in knots, is depicted by a green digital indication.



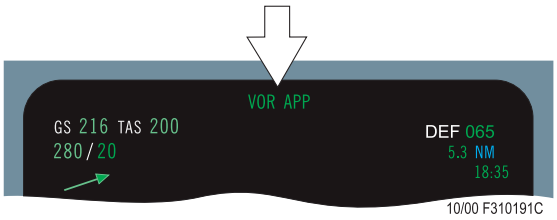
10/00 F310190C

ND Mode Common Information (continued)

Selected Approach

If a data base approach procedure has been entered into the flight plan, a selected approach indication is displayed at the top of the ND. These indications include:

- ILS APP (ILS and LOC approaches),
- VOR APP (VOR, VOR/DME approaches), or
- NDB APP (NDB approaches).

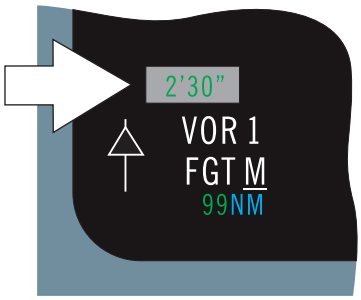


10/00 F310191C

Chronometer Display

The chronometer allows the pilot to monitor elapsed time. Each ND has an independent chronometer. Each depression of the chronometer pb performs a different function:

- First push - starts the chronometer and displays the elapsed time on the ND.
- Second push - stops the chronometer with the elapsed time displayed.
- Third push - clears the chronometer from the ND.



10/00 F310192C

ND Mode Common Information (continued)

Navaid Information

Selected Navaid Information - When a navaid is selected with a ADF/VOR selector switch, the navaid information is displayed:

- in the lower left corner for VOR 1 or ADF 1, or
- in the lower right corner for VOR 2 or ADF 1.

The ND displays navaid information by:

- the type of navaid tuned, and
- the navaid identifier using either the letter identifier, or the frequency identifier.

When DME information is available, it is depicted below the navaid identifier.

10/00 F310193C

Adjacent to the navaid information is a white symbol representing the associated ND needle.

Red Warning Flags - A red warning flag (VOR or ADF) replaces the navaid information when the associated navaid receiver has failed.

10/00 F310194C

Note: These warning flags do not appear unless the associated navaid has been selected with the ADF/VOR selector switch.

ND Mode Common Information (Continued)

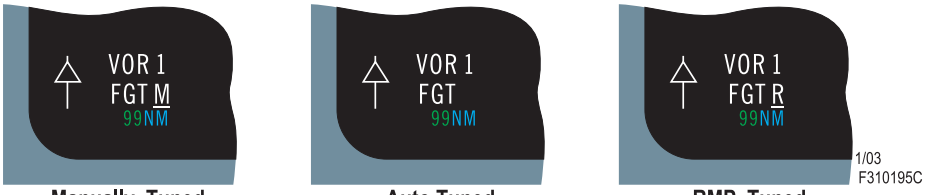
Navaid Information (continued)

When DME information is available, it is depicted below the navaid identifier.

Navaid Tuning - A navaid can be tuned using three methods (refer to chapter 34, Navigation):

- manually via the MCDU,
- automatically by the FMGCs, or
- manually via the RMP.

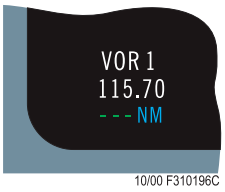
The tuning method is indicated on the ND as shown below:



Manually Tuned | Auto Tuned | RMP Tuned

Navaid Identification - The navaid frequency is displayed until the navaid identification is received.

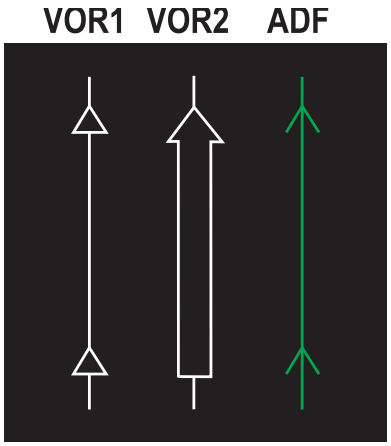
When the navaid identification is received, the three letter identification replaces the frequency.



ND Mode Common Information (continued)

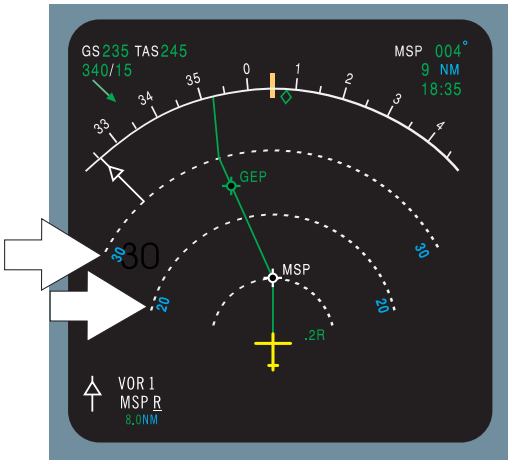
Navaid Information (continued)

Navaid Bearing Pointers - The bearing pointers for the VOR or ADF can be displayed in all ND modes, except PLAN, using the EFIS ADF/VOR selector switches.



10/00 F310197C

In the ND ARC mode, the range scales are depicted by white dashed arcs with range markers adjacent to the arcs. The maximum range of the arc is equal to the range selected on the EFIS range selector.



10/00 F310198C

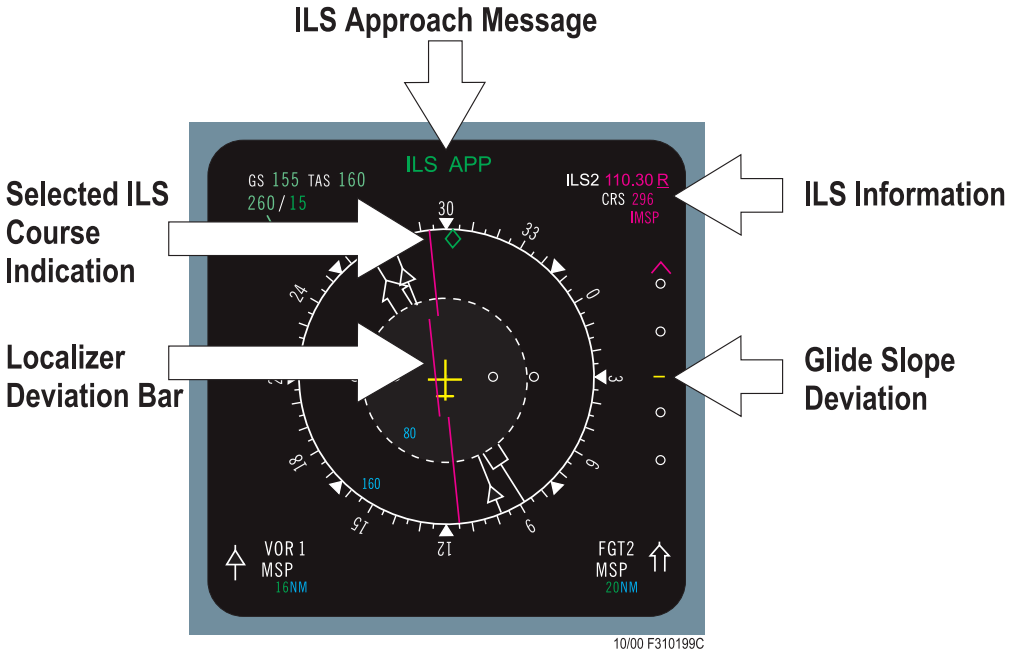
ND ROSE ILS Mode

Function

The ROSE ILS mode provides:

- an ILS display similar to a conventional Horizontal Situation Indicator (HSI),
- additional ILS information, and
- an ILS receiver backup capability.

All common ND information is also displayed.



Selected ILS Course Indication

The selected ILS localizer course is indicated by a magenta dagger.

When flying a localizer back course approach the front course ILS course should be entered. When this is accomplished, the ND localizer deviation indications are normal (needle left, turn left to correct).

Note: The PFD ILS indications are always reverse sensing when flying a localizer back course.

Localizer Deviation Bar

Deviation from the localizer course is depicted by the magenta localizer deviation bar, which appears when the localizer signal is received.

The localizer deviation scale and course indicator flash when there is excessive deviation from the localizer course after initial capture.

ND ROSE ILS Mode (continued)

Glide Slope Deviation

Deviation from the glide slope is depicted by:

- a magenta diamond when the aircraft is within two dots of the glide slope, or

10/00 F310200C

- a magenta half diamond when the aircraft is outside two dots (full scale deflection) of the glide slope.

10/00 F310201C

Note: The magenta diamond (or half diamond) only appears when the glide slope signal is being received.

The glide slope deviation scale and indicator flash when there is excessive deviation from the glide slope.

Additional ILS Information

ILS information is depicted in the upper right corner of the ND. This information is:

- the ILS receiver,
- the ILS frequency,
- the selected ILS course, and
- the ILS identification.

10/00 F310202C

Note: The ILS identification is depicted only when a valid ILS signal is being received.

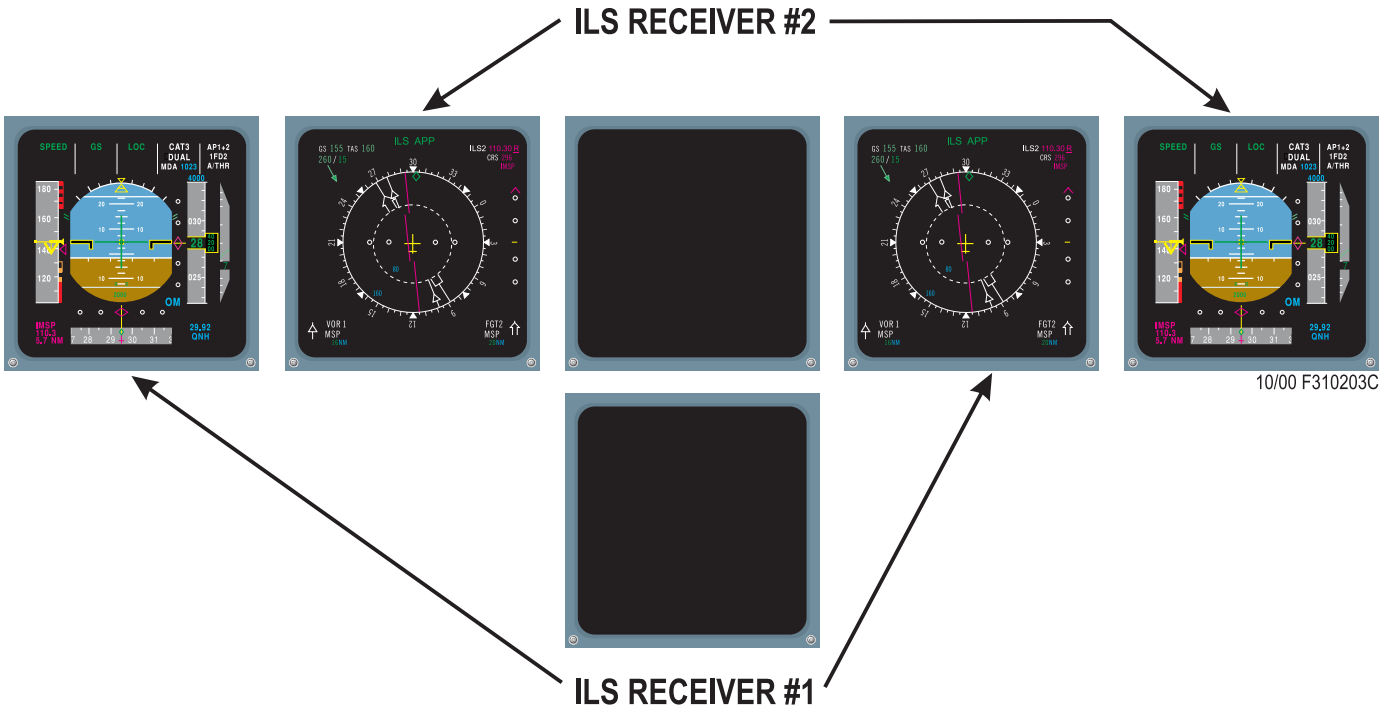
ILS APP Message

The ILS APP message is displayed when an ILS approach has been entered in the MCDU flight plan.

ND ROSE ILS Mode (continued)

ILS Receiver Backup Capability

Information from the two ILS receivers is displayed on the PFDs and ND as shown below:



This design allows either pilot to display ILS data using the ROSE ILS mode in the event the PFD ILS receiver fails. Both flight directors provide guidance from the remaining ILS receiver.

ND ROSE VOR Mode

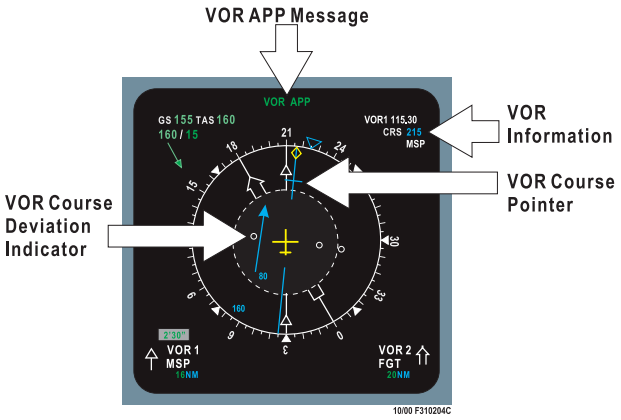
Function

The ROSE VOR mode provides a VOR display similar to a conventional HSI as well as additional VOR information. All common ND information is also displayed.

VOR Course Pointer

The selected course is indicated by a blue dagger. When approaching the desired, radial, the aircraft symbol can be turned to align with the dagger. This is meant to remind the pilot of the direction of turn.

The VOR course is selected either automatically by the FMS, manually through the MCDU, or manually through the RMP in backup mode.



VOR Course Deviation Indicator and Deviation Scale

The VOR Course Deviation Indicator (CDI) is displayed in blue. The arrow on the CDI shows the TO/FROM indication.

The VOR deviation scale also displays in blue. Each dot represents 5 degrees of deviation.

To display the VOR course deviation scale and the CDI, the correct VOR must be tuned. The captain's ND displays information from VOR 1 and the first officer's ND displays information from VOR2. The CDI does not appear until a valid VOR signal is received. The "TO" indication points towards the VOR station.

VOR Information

Additional VOR information is depicted in the upper right corner. This information provides the:

- VOR receiver,
- VOR frequency,
- selected VOR course, and
- VOR identification (when a valid signal is received).

VOR APP Message

The VOR APP message displays when a VOR approach has been entered in the MCDU flight plan.

ND ROSE NAV Mode

Function

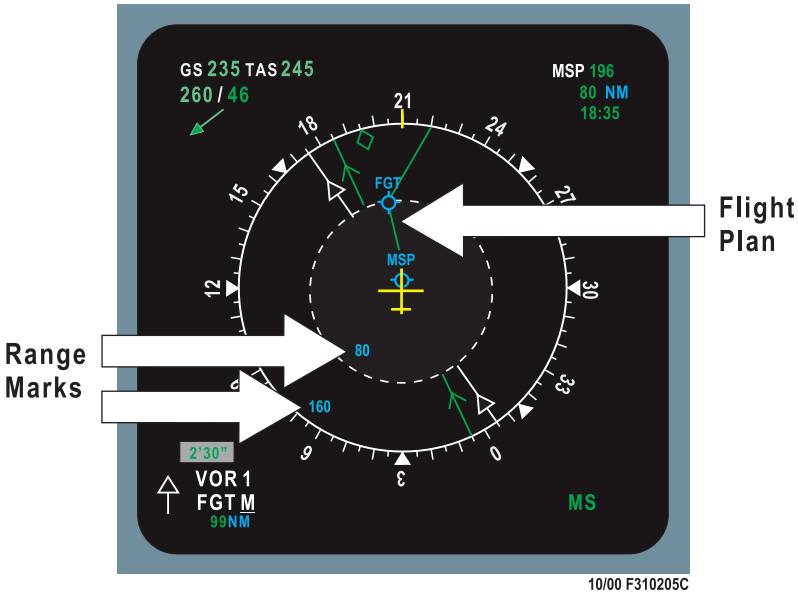
The ROSE NAV mode provides:

- a depiction of the aircraft position with reference to the flight plan inserted into the FMS, and
- additional information associated with the flight plan.

All common ND information is also displayed.

The ROSE NAV mode is depicted with a full compass rose oriented to the aircraft heading. This mode is particularly useful:

- for maintaining orientation when being vectored near an airport prior to approach, and
- when performing NDB and VOR approaches, allowing the head and tail of the bearing pointers to be monitored.



10/00 F310205C

Range Marks

The display is scaled according to the range scale value selected on the EFIS control panel. The values displayed are 1/4 of the selected range for the inner circle and 1/2 of the selected range for the outer circle.

ND ROSE NAV Mode (continued)

Flight Plan

Five different types of flight plans can be displayed. Each type of flight plan can be recognized by the color used to depict the flight plan segment. The color of the ND flight plan corresponds to the color of the MCDU flight plan segment. The flight plan types are the:

- active flight plan,
- secondary flight plan,
- temporary flight plan,
- alternate flight plan, and
- missed approach.

Active Flight Plan - The active flight plan is depicted by a green line.

Managed Flight - When the managed NAV mode is engaged, the active flight plan green line is solid. The FMS is providing lateral guidance in relation to the active flight plan. The flight guidance is steering the aircraft along the flight plan course (refer to chapter 22, Autoflight).

Note: During an ILS approach, the active flight plan green line is solid. However, flight guidance may be provided by the localizer. The FMA must be referenced to determine whether flight guidance is provided by the localizer (LOC mode) or by the FMS (NAV mode).

Selected Flight - When the active flight plan green line is dashed, lateral guidance follows the heading (or track) selected with the FCU.

10/00 F310206C

Secondary Flight Plan - The secondary flight plan is depicted by a solid white line and can be depicted at the same time as the active flight plan by depressing the MCDU SEC F-PLN key.

Note: If there are any common legs between the active and the secondary flight plans, only the active flight plan legs are displayed.

10/00 F310207C

ND ROSE NAV Mode (continued)

Flight Plan (continued)

Temporary Flight Plan - The temporary flight plan is depicted by a dashed yellow line on the ND when a revision to the active flight plan is being made.

10/00 F310208C

Missed Approach Flight Plan - The missed approach is depicted by a solid blue line, starting at the missed approach runway.

10/00 F310209C

Alternate Flight Plan - The alternate flight plan is depicted by a dashed blue line. If the alternate has been ENABLED, the alternate flight plan becomes the active flight plan and is displayed in green (refer to chapter 34, Navigation, MCDU Operations).

10/00 F310210C

ND ROSE NAV Mode (continued)

Flight Plan Offset

A flight plan offset is a course parallel to the active flight plan which the pilot can insert via the MCDU.

The pilot can preview a flight plan offset by creating a TEMP flight plan. The offset is then displayed in yellow, along with a yellow OFF SET, selected offset distance (in nautical miles) indication, and direction of the offset, left (L) or right (R). The aircraft position symbol remains on the original flight plan course.

10/00 F310211C

If the flight plan offset has been activated, the offset course is displayed as a solid green line, along with a green OFF SET and selected offset distance (in nautical miles) indication. The aircraft position symbol shifts to the offset course as the aircraft position moves to the new offset flight plan. The previous flight plan routing is displayed as a dashed green line.

10/00 F310212C

ND ROSE NAV Mode (continued)

Waypoints

Various kinds of waypoints can be displayed:

- active flight plan waypoints, and
- data base waypoints.

Active Flight Plan Waypoints - Active flight plan waypoints are represented by green diamonds. The diamond appears white if it is the next, or TO waypoint. When the pilot has selected WPT on the EFIS control panel, FMS data base waypoints which are not in the flight plan are displayed in magenta.

10/00 F310213C

Pseudo Waypoint - The pseudo waypoint is a point on the flight path where the aircraft will reach a selected or a constraint altitude or speed.

- pseudo waypoints:
  - level changes,
  - intercept,
  - constraint,
  - speed change, and
  - active or TO.

Level

Level Point (blue) - The symbol gives the point on the flight plan where the aircraft will reach the selected altitude when the CLB or DES mode is engaged. The symbol appears in magenta if it corresponds to a constraint.

10/00 F310214C

10/00 F310215C

Start of Climb or Top of Descent (T/D) - The symbol shows the point on the flight plan where the aircraft will leave the cruise flight level to initiate the climb or descent. The descent symbol also appears for a step descent.

10/00 F310216C

10/00 F310217C

The symbol is white before CLB or DES mode is armed. It is blue when the corresponding mode is armed.

ND ROSE NAV Mode (continued)

Waypoints (continued)

Intercept Point - A zigzag arrow symbol shows the point on the flight plan where the aircraft will meet the FMS computed vertical profile.

10/00 F310218C

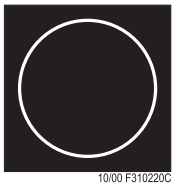
The symbol is white before the CLB or DES mode is armed. It is blue when the CLB or DES mode is armed.

10/00 F310219C

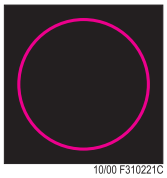
Constraint Waypoint - The vertical flight plan can display an altitude or a speed constraint.

Waypoints with constraints are displayed on the ND with a circle around the waypoint. The color of the circle is:

- white, when the constraint is being ignored. For example, the aircraft is not following the active flight plan (i.e. the aircraft is on a heading),


10/00 F310220C

- magenta, when the constraint is predicted to be met. For example, the aircraft is on the active flight plan and will cross the waypoint at the required altitude and/or speed, or


10/00 F310221C

- amber, when the constraint is predicted to be missed. For example, the aircraft is on the active flight plan and will not cross the waypoint at the required altitude and/or speed.

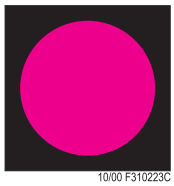
10/00 F310222C

These colors correspond to the colors depicted adjacent to the constraints on the MCDU. Refer to chapter 34, Navigation, for a complete discussion of vertical flight planning and constraints.

ND ROSE NAV Mode (continued)

Waypoints (continued)

Speed Change Waypoint - A magenta dot is displayed at the point where the aircraft automatically accelerates or decelerates (if in managed speed) to meet a speed limit, constraint, or to slow to holding speed.



Speed limits are normally associated with an altitude (e.g., 250 knots at 10,000 feet). This point moves if the point where the aircraft is predicted to be at the speed limit altitude (normally 10,000 feet) changes. Speed constraints and holding speed changes are associated with waypoints. The speed change dot is displayed prior to that waypoint

A magenta circled D is displayed at the DECEL point if the managed NAV mode is selected (refer to chapter 22, Autoflight). The aircraft will automatically slow to approach speed at this point. The FMS will automatically sequence to the APPR phase (refer to chapter 34, Navigation).

TO Waypoint - The TO waypoint on the active flight plan is normally depicted by a white diamond. The white color corresponds to the white color of the TO waypoint on the MCDU.

The TO waypoint bearing, distance (in nautical miles) and ETA is displayed in upper right corner of the ND.

Intercepting the F-PLN

The active flight plan is intercepted by entering the intercept legs via the MCDU (refer to chapter 34), and activating managed NAV mode (refer to chapter 22, Autoflight) while on an intercept heading.

When the intercept has been computed, the ND displays:

- a solid green line from the aircraft position to the intercept point,
- a white INTCPT symbol indicating the intercept point on the active flight plan,
- the bearing, distance and INTCPT point ETA, and
- the solid green active flight plan.

The previous active flight plan point (the FROM waypoint) is displayed for reference until the INTCPT is completed.

ND ROSE NAV Mode (continued)

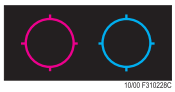
Navigation Station

Navigation stations are represented as follows:

DME or TACAN

VOR

VOR/DME



NDB

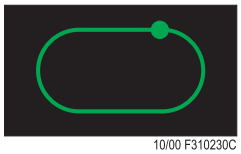
The symbol displays in:

- green if the station is a current waypoint of the flight plan,
- white if the station is the TO waypoint,
- blue when the station is tuned and selected for display either automatically by the FMS or manually through the MCDU, or
- magenta when the station is not already presented on the ND as part of the flight plan and is called for display as an option with the EFIS control panel.

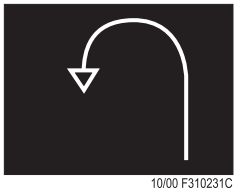
Holding Patterns

A holding pattern is depicted when the ND range selector is set at close ranges, and the holding pattern is part of the active flight plan.

The holding pattern and entry is depicted as a solid green line.



Note: When the ND range selector is set at longer ranges, the holding pattern is displayed as a white curving arc.



Note: The FMGC can depict a direct, parallel, or teardrop entry as necessary.

ND ROSE NAV Mode (continued)

Procedure Turns

A procedure turn is depicted:

- when it is part of an FMS data base approach procedure,
- the ND range selector is set to close ranges, or
- the procedure turn is part of the active flight plan.

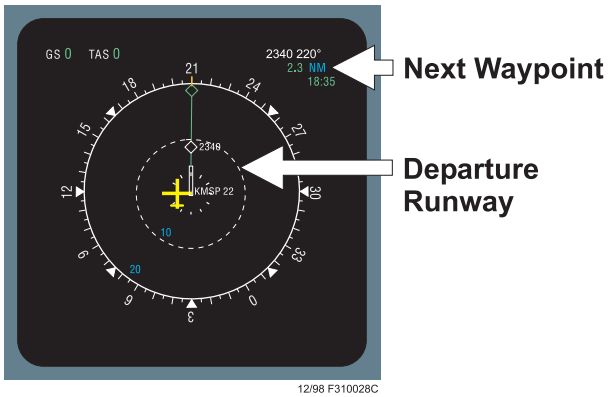
A procedure turn is depicted as a holding pattern.

Airports and Runways

When the runway has not been selected, flight plan departure, destination, and alternate airports are depicted by a white ICAO identifier and an asterisk (*).

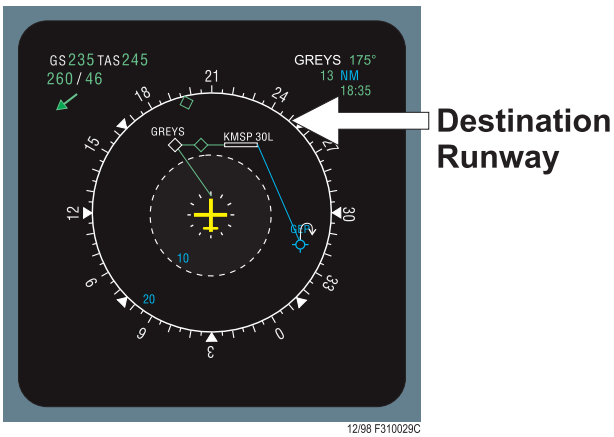
12/98 F310027C

Departure Runway - When entered via the MCDU, the departure runway and the runway identifier are depicted in white. The first waypoint in the flight plan is displayed in the upper right corner of the ND. This waypoint is normally the altitude at which the aircraft will reach the thrust reduction/acceleration altitude.



12/98 F310028C

Destination Runway - When entered via the MCDU, the destination runway and the runway identifier are depicted in white. In some cases, parallel or crossing runways are also depicted.



12/98 F310029C

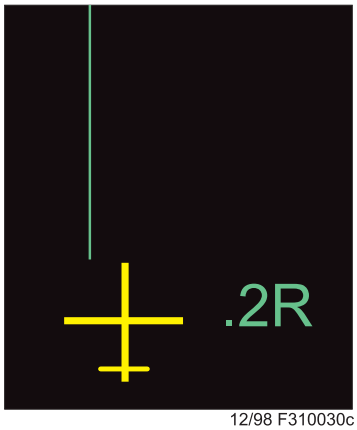
ND ROSE NAV Mode (continued)

Cross Track Error

The cross track error is displayed when:

- the pilot's FMGC is not the master FMGC, (this normally occurs when the opposite autopilot is engaged), and
- a significant difference exists between computed FMGC positions (refer to chapter 34, Navigation).

The cross track error is the lateral deviation between the FMGC positions. It is depicted by a digital indication in nautical miles left (L) or right (R) of course.



12/98 F310030c

It is also displayed on both ND’s when intercepting the active flight plan. A maximum value of 99.9 NM is displayed when the aircraft is off of the active flight plan.

ND ARC MODE

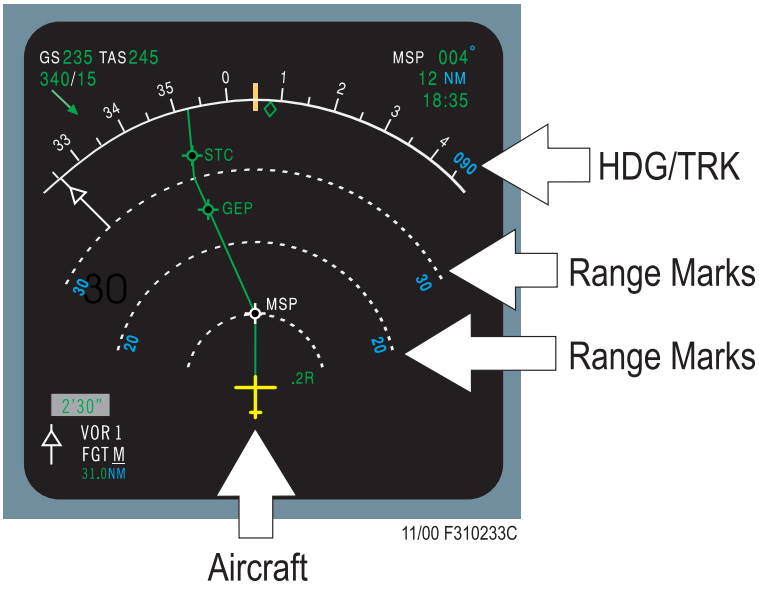
Function

The ARC mode provides the same information as the ROSE NAV mode but is limited to the forward 90 degree sector. This information includes:

- a depiction of the aircraft position with reference to the flight plan inserted into the FMGC, and
- additional information associated with the flight plan.

All common ND information is also displayed.

The ARC mode is depicted using a partial compass rose (approximately 90 degrees) oriented to the aircraft heading. The ARC mode provides the longest range map display (320 nm).



Aircraft Symbol

The yellow aircraft symbol is fixed.

Range Marks

The range mark values of the second and third inner arcs are equal to 1/2 and 3/4 of the range selected on the EFIS control panel.

HDG/TRK

If the selected heading or track is off scale, it is represented by digits. These digits will display on the left or right end of the HDG scale.

Other Symbols

For definitions of the other symbols, refer to the ROSE NAV mode.

ND PLAN Mode

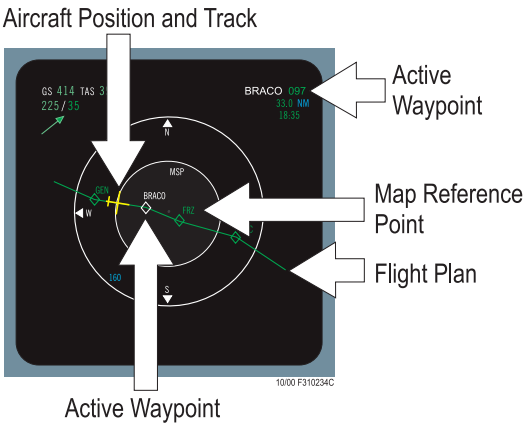
Function

The PLAN mode allows the pilot to preview future portions of the flight plan not displayed in the ROSE NAV or ARC modes. The PLAN mode uses a full compass rose oriented to true north.

The PLAN mode centers the display on the waypoint selected on line 2 of the MCDU flight plan page (or line 3, if line 2 is blank or is a pseudo waypoint). The entire flight plan can be displayed by scrolling through all waypoints. For example, the pilot could select the destination arrival fix during preflight planning and review the flight plan routing to the destination.

Weather radar, TCAS information, navaids, and associated bearing needles are not displayed in the PLAN mode. The aircraft position is displayed (when appropriate) on the PLAN mode.

All common ND information is also displayed.



Active Waypoint

The active waypoint information is displayed in the upper right corner.

This information is:

- the waypoint identification,
- the bearing to the waypoint,
- the range to the waypoint, and
- the ETA at the waypoint.

Aircraft Position and Track

The orientation of the yellow aircraft symbol indicates the aircraft true track. It's position represents the aircraft position as determined by the FMS.

Map Reference Point

This is the point that the PLAN Mode is centered on, as chosen by the pilot on the MCDU F-PLN page.

Flight Plan

The flight plan, is displayed, waypoint by waypoint, as the pilot scrolls through the flight plan on the MCDU. More of the flight plan is displayed as the range is increased, and vice versa.

See the ROSE NAV Mode for a description of the flight plan symbols.

ND Warning Flags and Messages

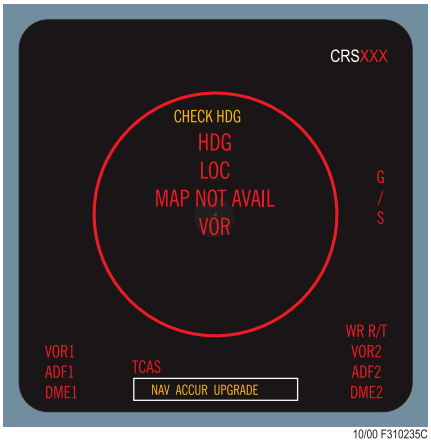
Red Flags

Warning flags for VOR and ADF receivers do not appear in the lower left and right corners of the ND unless the corresponding EFIS ADF/VOR selector switch has been selected for that receiver.

A complete list of red warning flags is provided at the end of this section.

Amber Messages

An amber message is depicted on the ND when a heading discrepancy has been detected between the captain's ND and first officer's ND. A number of other related systems (TCAS, FMGC) also display messages on the ND. In the example below, all flags and warnings are shown.



10/00 F310235C

A complete list of amber messages is provided at the end of this section.

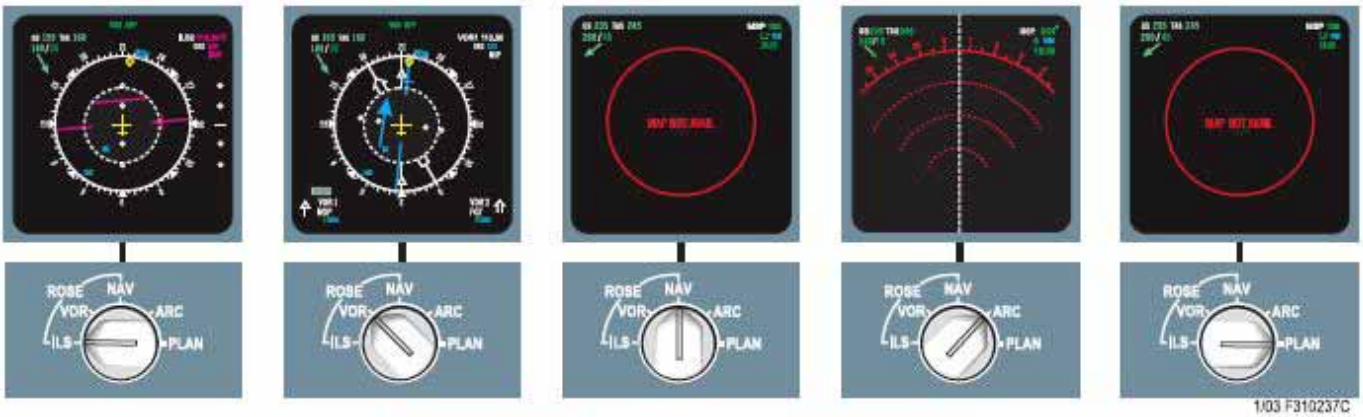
ND Degraded Modes

Single FMGC Failure

If one FMGC fails, the opposite FMGC can generate a display for both NDs. However, the FMGC can only generate one display range and mode. This display is determined by the EFIS ND range and mode selected by the pilot with the operating FMGC. The other pilot must set the EFIS ND range and mode to the same settings to see this display. The ROSE ILS and VOR ND modes continue to function independently. The pilot with the failed FMGC can recognize this failure by the following ND message:

Dual FMGC Failure

If both FMGCs fail, the ROSE ILS and ROSE VOR modes continue to function normally, allowing display of ILS, VOR, and NDB raw data.



1/03 F310237C

ECAM Switching Panel

Function

The ECAM switching panel allows the pilot to select backup displays. It is located on the pedestal

ATT HDG

The attitude and heading (ATT HDG) switch is used to select IRU 3 for attitude and heading information when IRU 1 or 2 fails.

NORM

- IRU 1 supplies PFD 1, ND 1, and DDRMI, or
- IRU 2 supplies PFD 2 and ND 2

CAPT 3 - IRU 3 replaces IRU 1

F/O 3 - IRU 3 replaces IRU 2

AIR DATA

The AIR DATA switch is used to select ADR 3 for air data information when ADR 1 or 2 fails.

NORM

- ADR 1 supplies PFD 1 and ND 1, or
- ADR 2 supplies PFD 2 and ND 2.

CAPT 3 - ADR 3 replaces ADR 1.

F/O 3 - ADR 3 replaces ADR 2.

EIS DMC

The EIS DMC switch is used to select DMC 3 when DMC 1 or 2 fails. With the switch in:

NORM

- DMC 1 supplies data to the captain's PFD, ND and the upper ECAM, or
- DMC 2 supplies data to the F/O's PFD, ND and the lower ECAM.

CAPT 3 - DMC 3 replaces DMC 1.

F/0 3 - DMC 3 replaces DMC 2.

ECAM Switching Panel (continued)

ECAM/ND XFR

The ECAM/ND transfer (XFR) switch allows the display on the lower ECAM to be transferred to either the captain's or F/O's ND. The ND image is not transferred to the lower ECAM display unit.

NORM - All displays are normal.

CAPT - The lower ECAM display is transferred to the captain's ND.

F/O - The lower ECAM display is transferred to the F/O's ND.

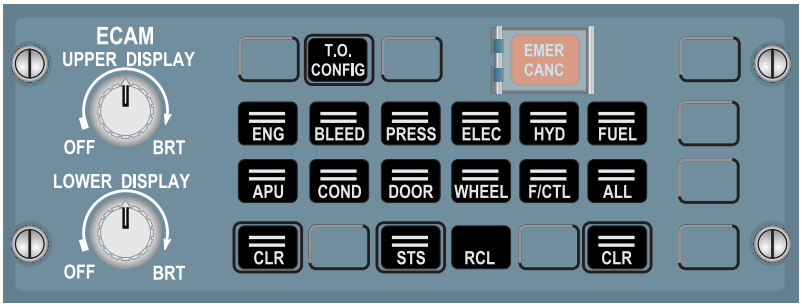
10/02 F310262C

ECAM Control Panel

Function

The ECAM Control Panel allows the pilot to manually select system display pages and other ECAM functions such as testing the takeoff configuration, canceling warnings, etc, as described below.

Note: The CLR, RCL, STS, EMER CANC, and ALL pbs are supplied with a different electrical supply than the system page pbs. In this way, they remain operative during certain electrical system abnormals.



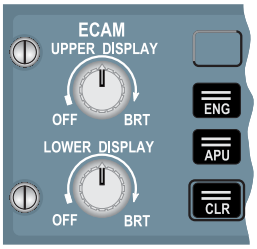
10/02 F310263C

OFF/BRT Knobs

These knobs control on, off, and brightness for the upper and lower ECAM displays.

The displays automatically adjust brightness with the changing light conditions. The manual brightness controls supplement this function.

Note: When the upper display knob is turned to OFF the upper ECAM image automatically moves to the lower display unit.



10/02 F310264C

System Pages pbs

When pressed once, the corresponding system page is displayed on the lower ECAM.

When the illuminated pb is pressed a second time, the system page corresponding to the current phase of flight is displayed.

The pb illuminates after manual selection or when an advisory is detected.

10/02 F310265C

RCL pb

When pressed, the warning/caution messages which have been cleared via the CLR pb or inhibited by the flight phase are recalled.

If there is no warning/caution present, the indication NORMAL displays for a short time.

If the RCL pb is pressed and held for approximately 3 seconds, emergency cancel warnings/cautions will be restored.

ECAM Control Panel (continued)

STS pb

When pressed, the STATUS page is displayed on the lower ECAM. If there is no status message present, NORMAL is displayed for a short time and then the page automatically clears.

The STATUS page may be cleared by the CLR pb.

CLR pb

The CLR pb illuminates white when:

- a warning/caution message is present on the upper ECAM, or
- a STATUS page message is present on the lower ECAM.

The CLR pb can be used to remove ECAM action steps that cannot be verified by the aircraft computers.

ALL pb

When pressed and held, all the system pages are displayed successively at short intervals.

In case of an ECAM control panel failure, the ALL pb can be used to select a system page by releasing the pb when the desired page appears.

EMER CANC pb

Pressing the EMER CANC pb allows the pilot to:

- cancel aural warnings, as long as the failure condition is present,
- cancel any current caution listed on the top line of the E/WD for the rest of the flight (ECAM message, master caution, and single chime), or
- store known system anomalies as per a MEL DDG procedure.

When a caution is canceled, the STATUS page is automatically displayed. The message CANCELED CAUTION and the title of failure inhibited appear.

A canceled caution message may be recalled by pressing the RCL pb for a short time.

T.O. CONFIG pb

When pressed, a takeoff power application is simulated. This test triggers a warning if the aircraft is not in the TO configuration, i.e.:

- slats or flaps not in the TO configuration,
- pitch trim not in the TO configuration,
- speed brakes not retracted,
- one door not closed,
- wheel brake overheat present, or
- one sidestick inoperative.

If the configuration is correct, the message TO CONFIG NORMAL displays on the upper ECAM.

Note: The aircraft doors are not tested as part of this warning before engine start.

MASTER CAUT & WARN pbs

Function

The function of the MASTER CAUT and MASTER WARN lights is to alert the pilot to an abnormal or emergency situation that is normally expanded upon on the upper ECAM page. (The ECAM describes the abnormal/emergency situation in detail and lists appropriate actions to correct the situation.)

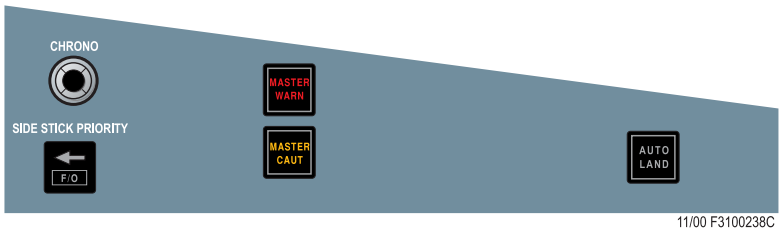
There are two MASTER CAUT and two MASTER WARN lights, one set on the captain's glareshield, one set on the first officer's glareshield. Each pair illuminates together; for example, the MASTER CAUT pb illuminates on both the captain's and first officer's sides.

The MASTER WARN pb illuminates red and is associated with a continuous repetitive chime.

The MASTER CAUT pb illuminates amber and is associated with a single chime.

The pbs automatically illuminate by a signal from the FWC. The lights on both sides, and the associated chime(s), are extinguished by pushing one of the illuminated pbs.

The pb lights can be tested with the annunciator light test switch (ANN LT), located on the lower part of the overhead panel.



11/00 F3100238C

Audio Warning

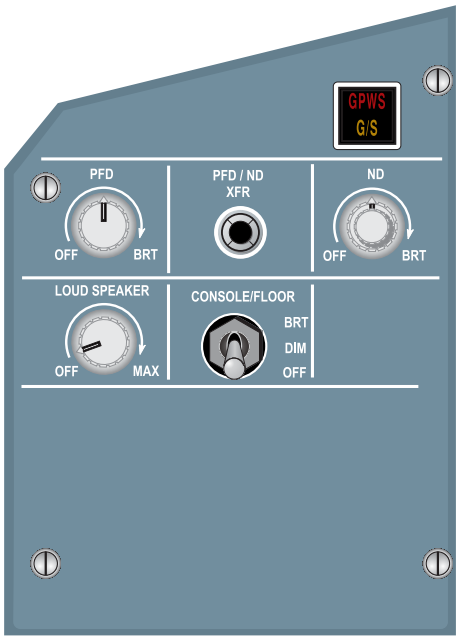
The aural warning associated with the MASTER CAUT and MASTER WARN comes from the cockpit speakers. The ON/OFF control or volume adjustment for the cockpit speaker does not affect the volume of the FWC aural warnings.

An aural altitude alert warning can be canceled by pressing either MASTER WARN light (the light will not be illuminated).

EFIS Display Unit Controls

Function

The display unit controls allow the pilot to turn on and adjust EFIS displays. The first officer's controls are installed in a mirror image to the captain's controls. The captain's controls are shown below.



10/02 F310266C

PFD Brightness Control

The PFD is off when the brightness control is rotated fully counter clockwise. When the PFD is turned off, the PFD image is automatically transferred to the ND if the ND is turned on.

ND Brightness Control

The inner knob controls the general brightness of the ND symbology.

The outer knob controls the brightness of the weather radar image only.

The ND is off when the brightness control is rotated fully counter clockwise.

PFD/ND XFR pb

When the PFD/ND transfer pb is depressed, the PFD and ND images (including weather radar image) are interchanged.

EFIS Control Panel

Function

The EFIS control panel allows the pilot to select desired EFIS information and ND modes. The captain's controls are installed in a mirror image to the first officer's controls. The first officer's controls are shown below.

11/00 F310240C

BARO Reference Display Window

The selected BARO units and value are displayed in the window. When the BARO reference knob has been pulled, STD is displayed indicating that the reference is 29.92 (or 1013).

BARO Reference Selector

Outer Ring - The outer ring enables selection of the units for baro reference, either in hectopascals (hPa) or inches of mercury (in Hg).

Inner Knob - Rotating the inner knob enables the selection of the reference value. This value is displayed in the baro reference window and on the PFD. A default setting of 1013 or 29.92 is initially displayed, depending on the unit selected.

Pulling the knob selects the standard barometric reference. STD is then displayed on the PFD below the altitude scale.

Pushing the knob when STD is displayed makes the QNH BARO setting available again.

EFIS Control Panel (continued)

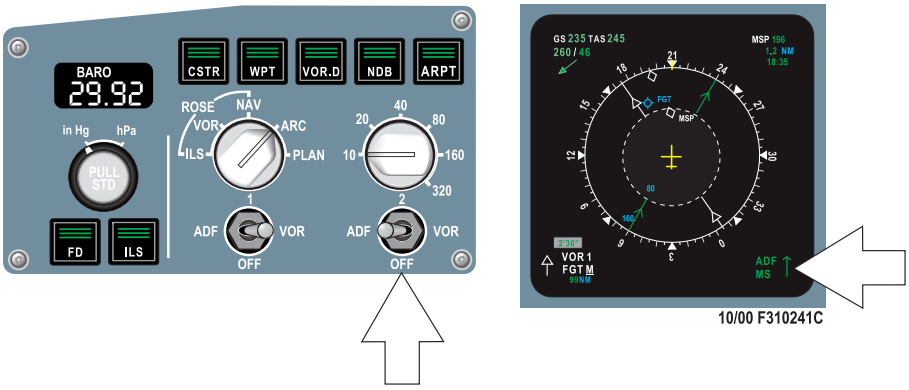
FD pb	When the FD pb is illuminated, flight director information is displayed on the associated PFD.
ILS pb	ILS localizer and glide slope scales are displayed on the PFD when: • an ILS frequency has been tuned, and • the ILS pb is depressed The ILS scales have priority over the VDEV indicator.
Mode Selector Switch	The mode selector switch allows the pilot to select the desired ND display mode.
Range Selector Switch	The range selector switch allows the pilot to select the desired ND range.

EFIS Control Panel (continued)

ADF/VOR Selector Switches

ADF information can be selected with either selector switch. ADF information is displayed in green, only on the ND. The tuned ADF frequency is displayed on the ND when the selector is in ADF. The ident and ADF bearing needle is displayed when the ADF signal is received.

If both selector switches are in ADF, only one ADF needle is displayed. The ADF data block is depicted in its respective corner.

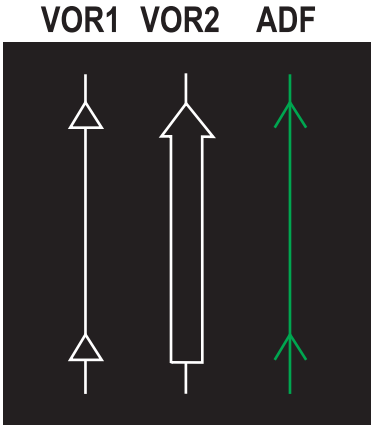


10/00 F310241C

VOR 1 information can be displayed on either ND with the number 1 selector switch, and VOR 2 information with the number 2 selector switch. The VOR frequency is displayed until the ident is received.

11/00 F310242C

VOR 1 needle is depicted as a single needle. VOR 2 is depicted as a double needle.



10/00 F310197C

EFIS Control Panel (continued)

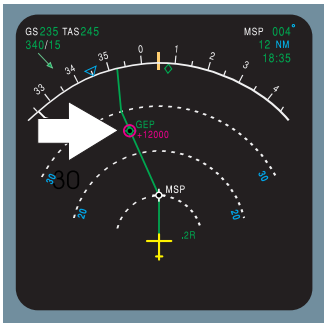
Optional Display pbs

The optional display pbs allow the pilot to display optional data base information.

11/00 F310243C

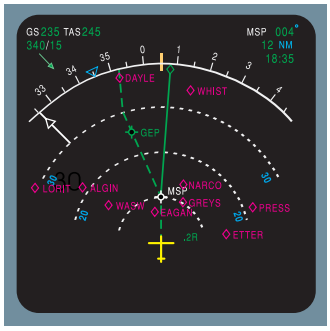
Caution: *Although possible, the selection of more than one optional display pb at a time is **not authorized**. Doing this may cause FCU electrical malfunctions.*

CSTR - The value of flight plan constraints (CSTRs) is displayed adjacent to the constraint.



11/00 F310244C

WPT - Data base waypoints not part of the flight plan are displayed in magenta.



11/00 F310245C

VOR.D - VORs, DMEs, and VOR/DMEs that are not tuned are displayed in magenta.

11/00 F310246C

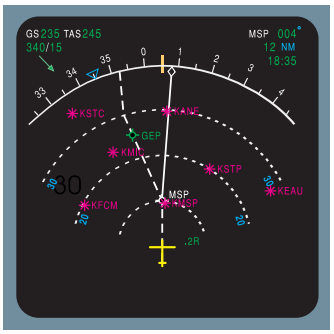
EFIS Control Panel (continued)

Optional Display pbs (continued)

NDB - NDBs that are **not** tuned are displayed as magenta triangles.

11/00 F310247C

ARPT - Displays the airports that are in the data base (may or may not be suitable emergency airport).



11/00 F310248C

In certain cases, all of the selected information cannot be displayed due to system design limitations. Selecting a shorter ND range may eliminate this condition.

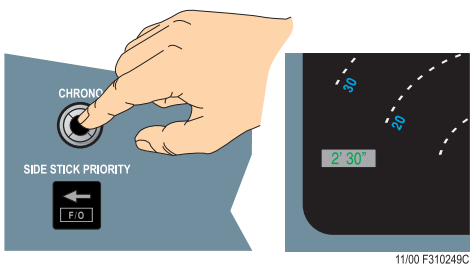
CHRONO pb

The chronometer pb is used to control the associated ND chronometer. Each depression of the pb performs a different function, as follows:

First push - starts the chronometer and displays the elapsed time on the ND.

Second push - stops the chronometer with the elapsed time displayed.

Third push - clears the chronometer from the ND.



11/00 F310249C

Standby Airspeed Indicator

Function

The standby airspeed indicator has an independent pitot-static system which bypasses the air data computers. The standby airspeed indicator is independent of the aircraft electrical system.

F310250C

Note: In the emergency electrical configuration, the standby airspeed indicator pitot heat is inoperative. If flying in icing conditions and a discrepancy exists between the airspeed displayed on the captain's PFD and the standby airspeed indicator, the PFD airspeed should be used.

Standby Altimeter

Function

The standby altimeter has an independent static system which bypasses the air data computers. The barometric pressure must be set independent of the EFIS altimeter setting. Except for the altimeter vibrator, the standby altimeter is independent of the aircraft electrical system. The altimeter vibrator only functions while the aircraft is airborne. Therefore, significant differences between altimeters may be noted on the ground.

The standby altimeter barometric pressure is set with a knob on the altimeter. The barometric pressure setting may be either in HG or hPa depending on the installed altimeter.

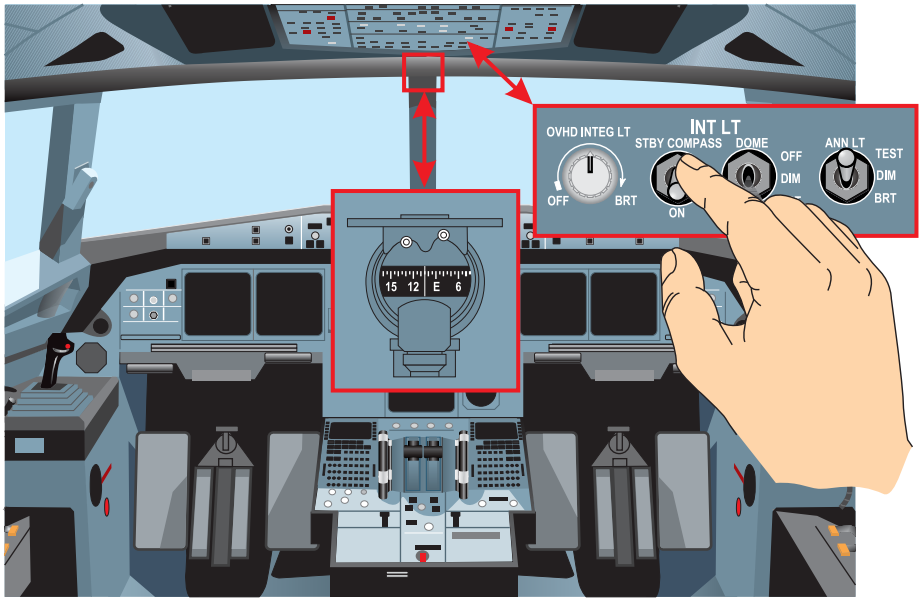
F310251C

Standby Compass

Function

The standby compass is displayed by pulling down on the access panel.

The compass light is controlled by a switch on the overhead panel.



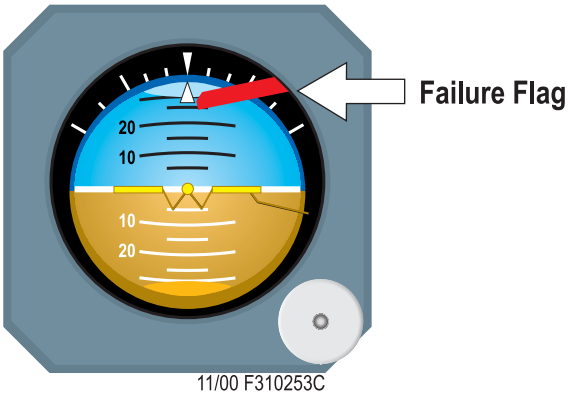
11/00 F310252C

Standby Horizon

Function

The standby horizon provides a backup attitude reference in the unlikely event of complete IRU or EFIS failure. In case of total electrical failure, the indication remains available for approximately 5 minutes.

The standby horizon is caged by pulling the pull to cage knob. A loss of electrical power results in the red ATT flag being displayed.



11/00 F310253C

DDRMI

Description

The aircraft is equipped with a Digital Distance and Radio Magnetic Indicator (DDRMI).

Heading Flag - The warning flag is displayed when the heading signal is invalid. This flag is normally displayed during IRU alignment (refer to chapter 34, Navigation). Both VOR flags are always displayed with the heading flag displayed.

Compass Card - The compass heading is supplied by the same IRU as the captain's PFD (refer to chapter 34, Navigation). With the ECAM switching panel ATT HDG switch in NORM, heading is supplied by IRU 1. With the switch in CAPT 3, heading is supplied by IRU 3.

Bearing Pointers - The bearing pointers indicate the magnetic bearing to VOR 1 (single dashed needle) and VOR 2 (double solid needle).

VOR 1 (2) Flags - The red VOR 1 (2) flags are displayed when:

- the VOR receivers are not tuned to a station,
- the VOR receiver has failed,
- an internal failure of the DDRMI,
- a power supply failure, or
- the ADIRU heading signal is invalid.

Note: The red VOR flags will be displayed until a VOR signal is received.

DME - DME 1 (2) distances are displayed in nautical miles. Tenths of nautical miles are displayed at ranges below 20 NM. At distances less than 1 nautical mile, 0 is displayed.

Aircraft Clock

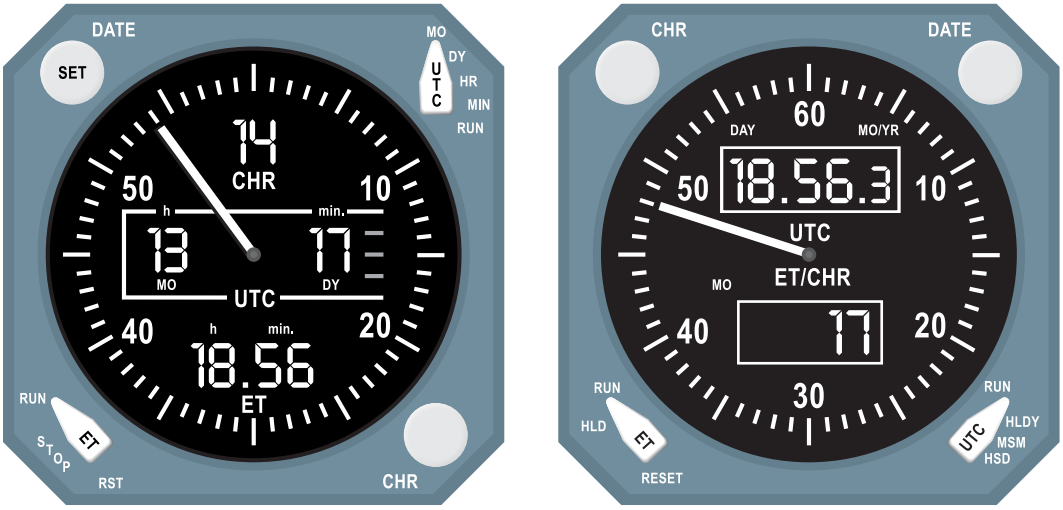
General

The aircraft clock is designed to provide the FMGCs, AIDS, CFDS and other aircraft systems with a time reference as well as a day, month and year reference.

One of two manufacture's model is installed. Both models however operate in the same manner with some slight control differences.

- Air Precision (Older version): On most A320s, or
- Smiths (Newer version): On all A319s and some A320s.

The clocks are normally powered by the aircraft batteries but, are each equipped with an internal battery that can maintain clock operation for up to 50 hours.



F310283C

Air Precision Model
(Older model on most A320s)

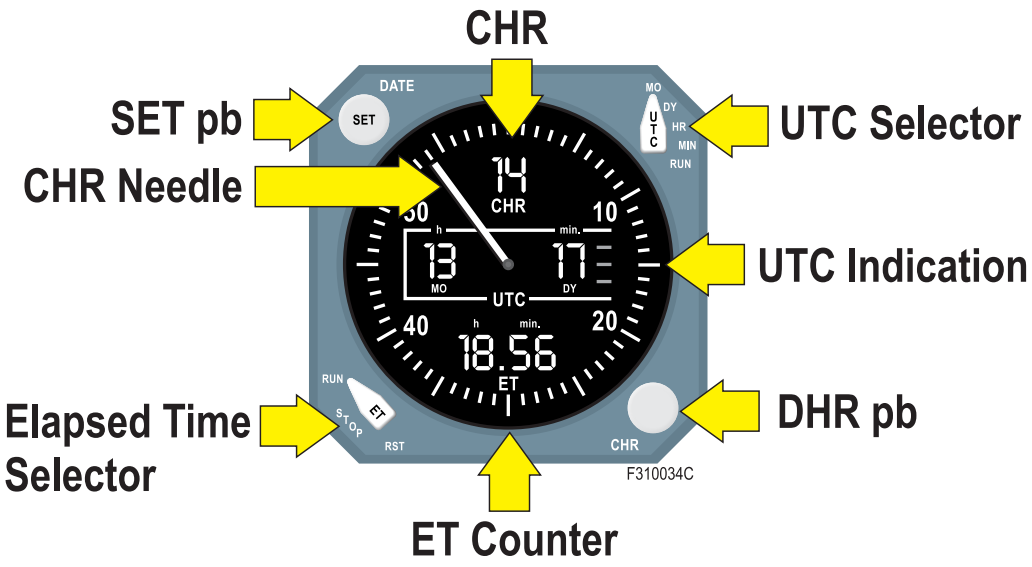
Smiths Model
(Newer model on all A319s and some A320s)

Note: ACARS UTC is automatically updated from the ACARS network on non-ATSU (Air Traffic Service Unit) equipped aircraft. Aircraft which are ATSU equipped, the ACARS UTC is updated directly from the aircraft clock.

Aircraft Clock (continued)

Air Precision Model Clock

The Air Precision model is found on most A320s:



UTC Indication

UTC time is displayed digitally in a 24 hour format. Horizontal marks to the right of the digital time divide a minute into four parts, with:

- no marks from 0-14 seconds,
- one mark from 15-29 seconds,
- two marks from 30-44 seconds, or
- three marks from 45-59 seconds

ET Counter

This counter registers the elapsed time up to 99 hours 59 minutes.

CHR

Display of the sum of the minutes. The display is controlled by the CHR pb.

CHR Needle

The needle indicates the chronograph seconds. The needle is controlled by the CHR pb.

CHR pb

The CHR pb controls the CHR sweep second hand and the digital CHR elapsed minutes indication. Pushing the CHR pb results in the following:

- First push - the sweep second hand and the digital CHR indicator start.
- Second push - the sweep second hand and the digital CHR stop.
- Third push - the sweep second hand is stowed at the twelve o'clock position and the digital CHR indicator is cleared.

Aircraft Clock (continued)

UTC Selector

To update the clock, the UTC selector is moved to the desired setting. These settings are:

- MO (Month), which displays the month, and the year is displayed in the lower display,
- DY (Day),
- HR (Hour),
- MIN (Minute), and
- RUN starts the UTC counter.

Note: Push and turn the selector to switch from MIN to RUN.

SET pb

To change the setting on the UTC Indication, the SET pb is:

- turned to either side to increment, and
- pushed and held to decrement.

Elapsed Time Selector

The elapsed time (ET) selector controls the digital ET counter.

- RUN - causes the digital ET counter to start. Elapsed time in minutes only is displayed (up to 99 hours and 59 minutes).
- STOP - causes the digital ET counter to stops. Elapsed time is displayed.
- RST - clears and resets the digital ET. The selector is spring-loaded to the STOP position.

Clock Updating

To update the clock, the UTC selector is moved to the desired setting. To change the setting, the SET pb is:

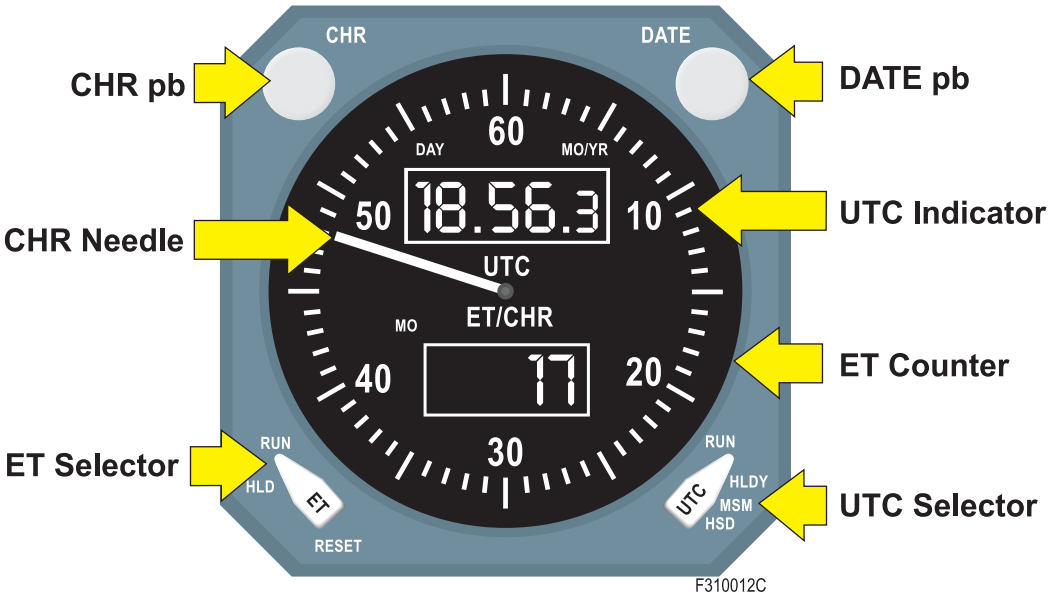
- turned to either side to increment, or
- pushed and held to decrement.

Once updated, the UTC selector is moved to RUN.

Aircraft Clock (continued)

Smiths Model Clock

The Smiths model is found on all A319s and some A320s:



UTC Indication

Two modes of display are possible, date and time. UTC is displayed digitally in a 24 hour format when in the time mode. The date (day, month and year) is displayed in the date mode.

ET Counter

This counter registers the Elapsed Time (ET) up to 99 hours 59 minutes.

CHR Needle

This needle indicates the chronograph (CHR) seconds. The display is controlled by the CHR pb.

CHR pb

The CHR pb controls the CHR sweep second hand and the digital CHR elapsed minute indication. Pushing the CHR pb results in the following:

- First push - starts the sweep second hand and the ET/CHR display.
- Second push - the sweep second hand and the digital ET/CHR indicator stop.
- Third push - the sweep second hand is stowed at the twelve o'clock position and the digital ET/CHR indicator is cleared.

Aircraft Clock (continued)

UTC Selector

To update the clock, the UTC selector is moved to the desired setting. These settings are:

- RUN
  - starts the UTC counter
- HLDY
  - stops the UTC counter when in the time mode, and
  - advances the years when in the date mode.
- MSM
  - advances the minutes when in the time mode, and
  - advances the months when in the date mode.
- HSD
  - advances the hours when in the time mode, and
  - advances the days when in the date mode.

Date pb

This pb selects the UTC display mode. Pushing the pb results in the following:

- First push: sets the clock to the date mode. The date display (day, month, year) replaces the UTC time display.
- Second push: sets the clock to the time mode. The UTC time display reappears.

Note: In order to switch modes, the UTC selector must be set to RUN.

ET Selector

The Elapsed Time (ET) selector controls the digital ET/CHR counter.

- Run - causes the digital counter to start.
- HLD (Hold) - causes the digital ET counter to stop at the last indication.
- RESET- clears and resets the ET/CHR display. The selector is spring-loaded to the HLD position.

Clock Updating

To update the hour and minute:

- press the Date pb to select the TIME mode. Hour and minutes will be displayed,
- set the UTC selector to HSD to set the current hour and MSM to set the current minute,
- the digits advance while the UTC selector is left in the desired position, and
- once updated, return the UTC selector to RUN.

To update the day, month and year, press the Date pb to select the date mode. Proceed in the same way as above, using MSM to advance month or HLDY to advance years.

- once updated, return the UTC selector to RUN

ECAM CLOCK

Description

UTC time is displayed on the bottom of the lower ECAM whenever a Systems Display page is present

This time is synchronized with the flight deck clock.

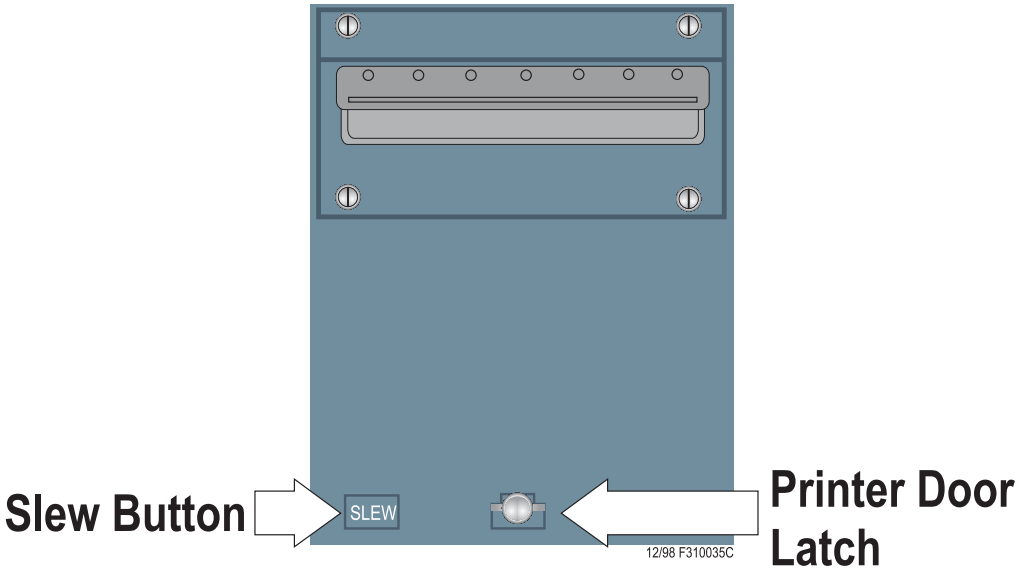
5/99 F310044C

Cockpit Printer

Function

The printer prints reports from the systems connected to it, such as ACARS and the CFDS. The printer works on the ground and in flight.

The printer is installed at the right rear of the center pedestal.



SLEW Button

The SLEW button on the flight deck printer is used for advancing the paper after loading.

Printer Door Latch

Paper loading is accomplished through the printer door. The printer door latch locks.

DFDR Recorder Controls

Description

The Digital Flight Data Recorder (DFDR) is normally automatically controlled. The DFDR is automatically energized:

- on the ground for a short period after electrical power is applied to the aircraft,
- on the ground with an engine running, or
- continuously when airborne.

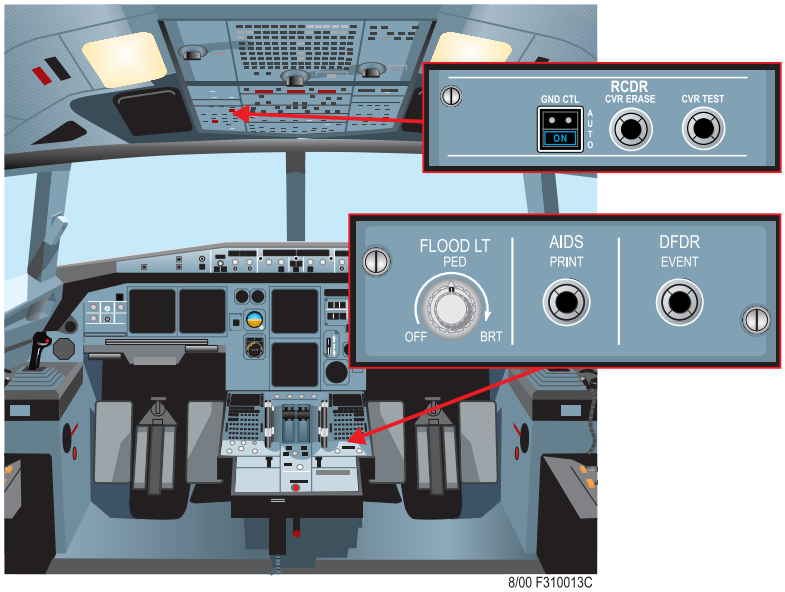
When on the ground, the DFDR automatically stops soon after the second engine shut down.

The DFDR can be manually energized. The DFDR tape can also be marked by the pilot.

GND CTL Switch

This switch is located on the overhead panel.

The DFDR is manually energized (prior to engine start) on the ground when the overhead panel GND CTL pb is ON.

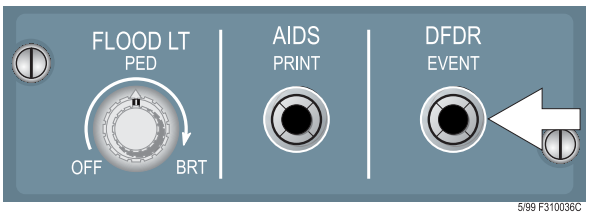


8/00 F310013C

DFDR EVENT pb

This pb is located on the pedestal

The pilot can mark the DFDR tape by depressing the pedestal DFDR EVENT pb. This allows a particular event to be easily located on the DFDR tape..

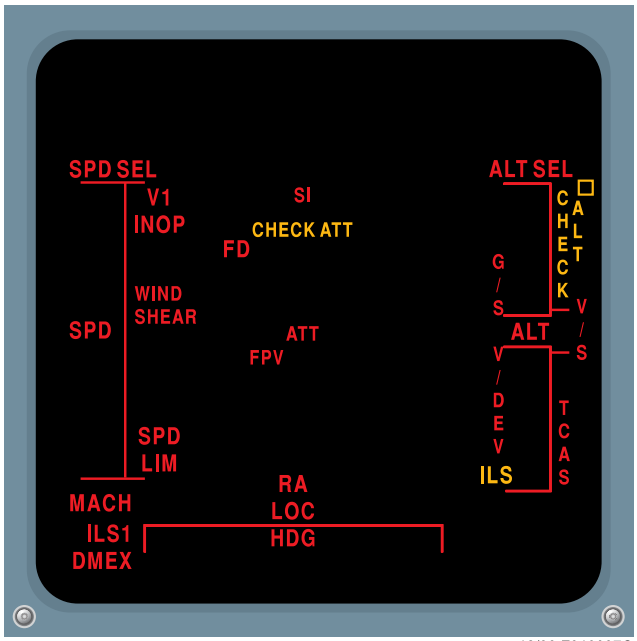


5/99 F310036C

PFD Warnings and Messages

Description

Red warning flags are displayed on the PFD to indicate component failures. Amber messages indicate a discrepancy between instruments or other significant messages. The warning flags replace the indication which has failed.



12/98 F310037C

Note: The WIND SHEAR warning indicates that windshear has been detected. This is not a failure indication.

PFD Warnings and Messages (Continued)

Red Warning Flags

Red warning flags are summarized in the table below:

Warning Flag	Meaning
ATT	The attitude indicator has failed (IRU attitude failure)
SI	Side slip information is lost
FPV	The TRK/FPV mode has been selected and both flight directors have failed
FD	Both flight directors have failed
SPD	The airspeed indicator has failed (ADR failure)
SPD SEL	The pilot has not entered takeoff performance speeds via the MCDU, or the selected speed function has failed
SPD LIM	All characteristic speed information (Vls, S, F, Green dot, etc) has been lost due to dual FAC failure
V_1 INOP	The V_1 signal is not valid
ALT	The altimeter is inoperative (ADR failure)
ALT SEL	The selected altitude indication is inoperative
V/S	Vertical speed information is inoperative (IRU and ADR failure)
G/S or LOC	The G/S or LOC receiver associated with that PFD has failed
V/DEV	Vertical deviation information is inoperative
RA	Both radar altimeters have failed
HDG	Heading information is inoperative (IRU failure)
MACH	Mach data has failed (ADR failure)
DME 1 or 2	ILS DME information is inoperative (DME 1 on PFD 1, DME 2 on PFD 2)
ILS 1 or 2	ILS receiver has failed (ILS 1 on PFD 1, ILS 2 on PFD 2)
TCAS	TCAS has failed (refer to chapter 85). Vertical commands due to resolution advisories will not be displayed
WINDSHEAR	Windshear has been detected (refer to chapter 22)

Amber Messages

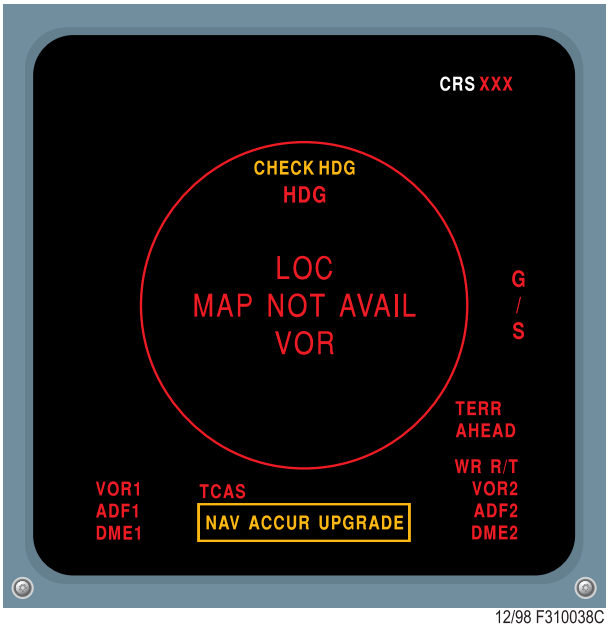
Amber messages are summarized in the table below:

Amber Message	Meaning
CHECK ATT	Significant discrepancy between attitude indicators
CHECK ALT	Significant discrepancy between altimeters or altimeter settings
DH	The aircraft has descended below the decision height
CHECK HDG	Discrepancy between heading indicators
ILS (flashing)	An ILS frequency has been tuned, the FCU APPR or LOC pb is armed, and ILS deviation scales are not displayed
V/DEV (flashing)	Approach nav has been armed with the FCU APPR pb and the EFIS ILS pb is illuminated

ND Warnings and Messages

Description

Red warning flags are displayed on the ND to indicate component failures. Amber messages indicate discrepancy between instruments or other significant messages from related systems. The warning flags replace the indication which has failed.



12/98 F310038C

Red Warning Flags

Red warning flags are summarized in the table below:

Warning Flag	Meaning
HDG	The ND heading source has failed
LOC	The localizer receiver is inoperative
VOR	The VOR receiver is inoperative
G/S	The glideslope is inoperative
VOR 1(2),ADF 1, DME 1 (2)	The identified receiver is inoperative
CRSXXX	The VOR course has failed
MAP NOT AVAIL	The FMGC has failed or the aircraft position is not valid. Cycling ND mode may correct this problem.
WXR XXX	A failure has occurred in the weather radar. Refer to the COM section 3.34.
TERR AHEAD	EGPWS terrain warning (refer to chapter 85)
TCAS	The TCAS has failed (refer to chapter 85)

ND Warnings and Messages (continued)

Amber Warning Flags

Amber warning flags and messages are summarized in the table below:

Warning Flag	Meaning
CHECK HDG	A significant difference has been detected between the captain's and first officer's heading
MAP PARTLY DISPLAYED	The DMC is unable to display all of the requested data. Selecting a shorter ND range may correct this problem.
NAV ACCUR DOWNGRAD NAV ACCUR UPGRAD	Indicates a change in FMGC navigation accuracy
SPECIF VOR/D UNAVAIL	The navaid which is tuned for the selected approach or departure is not available
CHECK ADF 1 CHECK VOR 1 (2) CHECK ILS 1 (2)	Indicates that a discrepancy between ident tuned by the FMGC and the ident received from the navaid
SET OFFSIDE RNG/MODE	Displayed on ND with corresponding FMGC failure. Matching EFIS range and mode to opposite ND selections allows opposite FMGC to provide ND display
OFST R (L) XX	Displayed when a temporary or an offset F-PLN is entered. The offset value is given in NM
WXR XXX	A degradation in the weather radar has occurred. Refer to the COM section 3.34.
TERR AHEAD	EGPWS terrain caution (refer to chapter 85)

Green Messages

Green messages are summarized in the table below:

Green Message	Meaning
MODE CHANGE	The DMC is preparing a new page due to an EFIS mode change
RANGE CHANGE	The DMC is preparing a new page due to an EFIS range change

ECAM Aural Warnings

Aural Warnings

Most ECAM aural warnings can be canceled by depressing the MASTER WARN pb. All aural warnings may also be canceled by depressing the EMER CANC pb on the ECAM control panel. However, the EMER CANC pb also causes this warning to be cancelled for the remainder of the flight. (All cancelled aural warnings can be restored by holding the RCL pb for approximately 3 seconds.)

ECAM aural warnings are summarized in the following table:

Aural Warning	Condition	Duration	Silencing
CONTINUOUS REPETITIVE CHIME (CRC)	RED WARNINGS	PERMANENT	Depress MASTER WARN pb
SINGLE CHIME	AMBER CAUTIONS	1/2 second	
CAVALRY CHARGE	A/P DISCONNECT BY TAKEOVER pb	1.5 second	Second push on takeover pb
CAVALRY CHARGE	A/P DISCONNECT BY FAILURE (refer to chapter 22)	PERMANENT	Depress MASTER WARN pb or TAKEOVER pb
TRIPLE CLICK, (CRICKET)	LANDING CAPABILITY CHANGE (refer to chapter 22)	1/2 second (3 pulses)	
C CHORD	ALTITUDE ALERT (refer to chapter 85)	1.5 seconds or PERMANENT	New ALTITUDE selection or depress MASTER WARN pb (not illuminated)

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Chapter 32: Landing Gear

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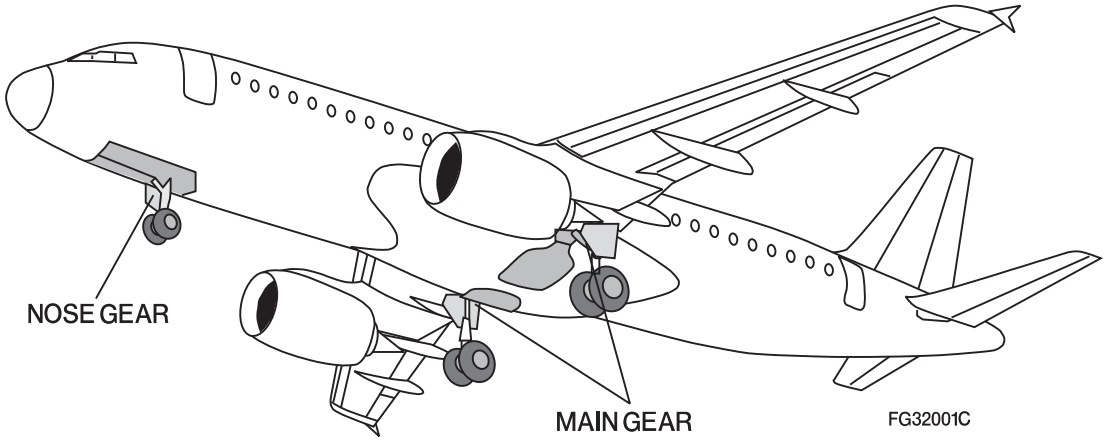
System Description

Location of Landing Gear and Brake Components

Introduction

The A319/320 is equipped with:

- a steerable nose landing gear with two wheels, and
- two main landing gear with two wheels on each gear.



General Description

Purpose

The Landing Gear system is installed to permit high speed operation of the aircraft in flight and efficient maneuvering of the aircraft while on the ground.

System Breakdown

The major components of the Landing Gear system include:

- landing gear and doors,
- nose wheel steering, and
- brakes with anti-skid.

Overview

The landing gear consists of the nose gear, which retracts forward, and the main gear, which retracts inboard.

The nose gear is equipped with a steering system. There are no brakes on the nose wheels.

Each of the main landing gear has a set of carbon disc brakes. The main landing gear is also equipped with autobraking. An anti-skid system provides maximum braking to the point of an impending skid.

Controls and indicators for the landing gear, anti-skid, and nose wheel steering are located on the center instrument panel. The parking brake and gravity gear extension handle are located at the rear of the center pedestal. Nose wheel steering is controlled by steering handwheels located on each pilot's side console and by the pilot’s rudder pedals.

System information is displayed on the ECAM WHEEL page. The ECAM Memo section displays supplementary systems status information, including warnings.

Landing Gear and Doors

Main Gear and Door Assembly

There are two main gear, each fitted with a pair of tire/wheel assemblies.

The main gear retract inboard.

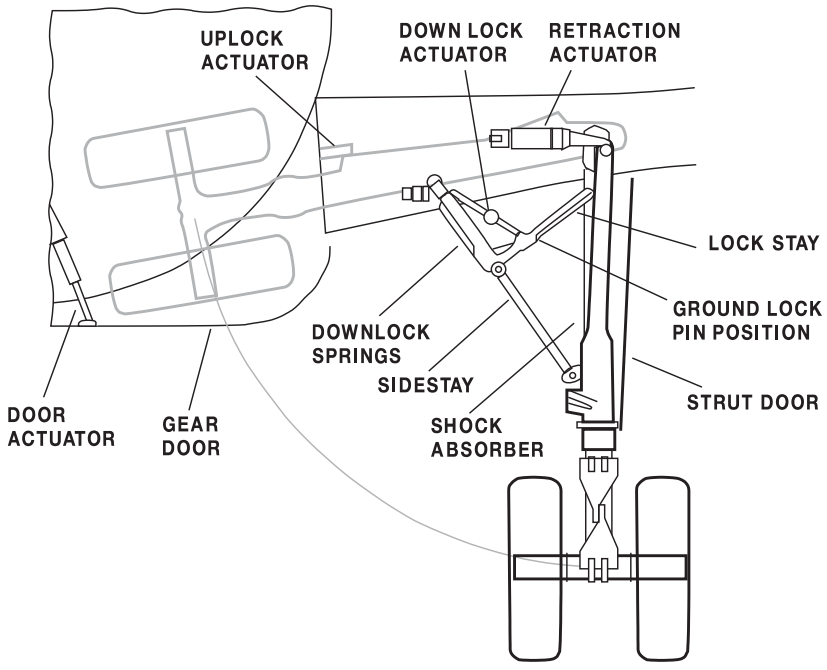
The main gear and doors are electrically controlled and hydraulically operated.

Outer gear doors are attached to the main gear struts and move with the gear. Inner gear doors are hinged at the fuselage and are sequenced to initially open with gear retraction or extension and close at the completion of the sequence.

Note: The landing gear indicator panel and the ECAM WHEEL page are the only indications that the gear are down and locked. No other means exist to verify that the gear are down and locked.

Main Gear Diagram

The following diagram illustrates the components of the main landing gear.



Landing Gear and Doors (Continued)

Nose Gear and Door Assembly

There is one steerable nose gear, fitted with a pair of tire/wheel assemblies. The nose gear retracts forward.

Nose gear doors are fitted to either side of the nose gear well and are hydraulically sequenced to open, then close during nose gear extension and retraction.

The nose gear is totally enclosed after gear retraction.

Note: The landing gear indicator panel and the ECAM WHEEL page are the only indications that the gear are down and locked. No other means exist to verify that the gear are down and locked.

The following lights are installed on the nose gear:

- two runway turn-off lights,
- a taxi light,
- a landing light, and
- a parking brake set indication light.

All of the lights extinguish with the landing gear retracted.

Nose Gear Diagram

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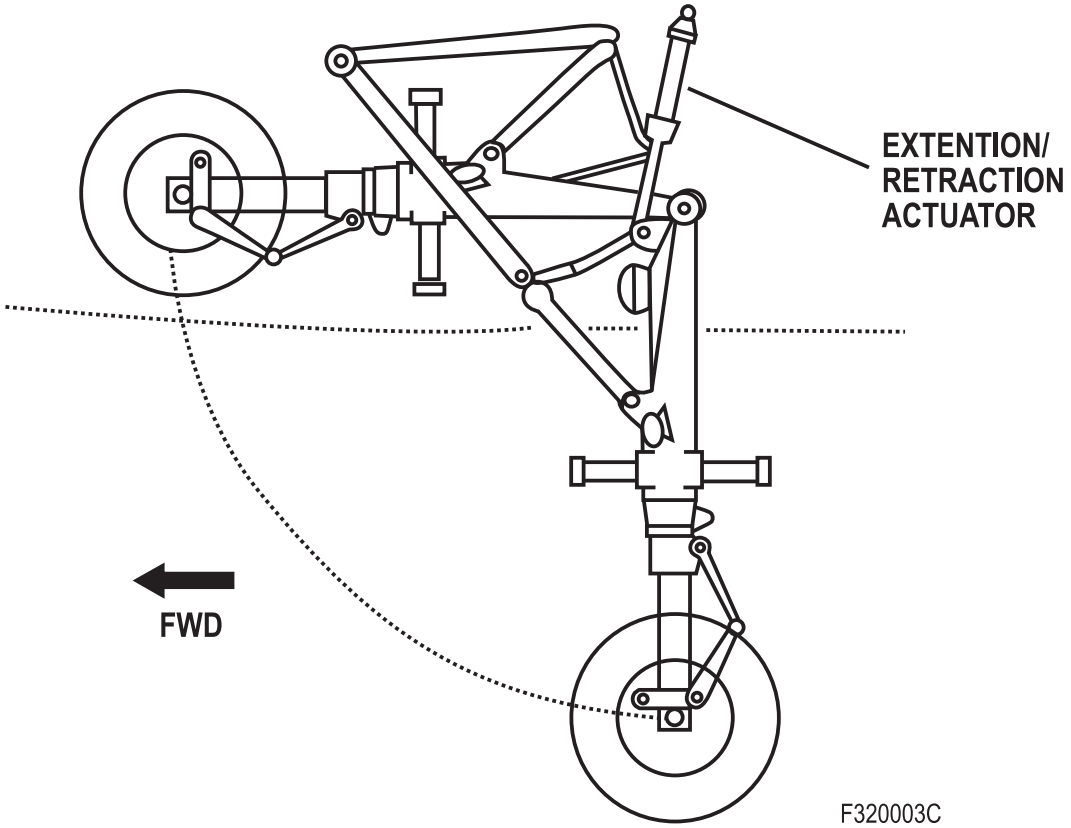


Landing Gear and Doors (Continued)

Landing Gear Controls

Landing gear controls and indicators are located on the center instrument panel.

Two Landing Gear Control Interface Units (LGCIU) process gear position, sequencing information, and gear lever selection. The LGCIUs also provide landing gear warning information to the ECAM.

When the landing gear is selected down, the ECAM WHEEL page appears. Double green triangles represent the landing gear in the down locked position. The active LGCIU is represented by the front triangle. The rear triangle represents the inactive LGCIU. The front and rear positions do not necessarily represent LGCIU 1 and 2 respectively.

In the event of hydraulic or electrical power supply failure, a hand crank is provided on the center pedestal for gravity extension.

Normal Extension and Retraction

Normal extension and retraction of the landing gear is controlled with a lever on the forward instrument panel.

Power is provided by the green hydraulic system. A gear safety valve shuts off the hydraulic power to the gear system when the indicated airspeed is above 260 kts, preventing normal retraction and extension.

Gear and door sequencing is electrically controlled by LGCIU 1 or 2. The LGCIUs alternate at each landing gear retraction cycle, or in the case of a LGCIU failure.

Proximity detectors provide feedback to the LGCIU's regarding gear and door operation.

At liftoff, as the strut extends, the nosewheel is automatically centered by internal cams.

If the main or nose gear shock absorbers are compressed, or if the nosewheel is not centered, an interlock will prevent the raising of the gear. This prevents retraction on the ground.

Landing Gear and Doors (Continued)

Gravity Extension

The landing gear can be gravity extended manually from the flight deck by means of a crank handle.

When the crank handle is removed from the stowed position and cranked clockwise, the first turn cuts off the hydraulic pressure to the landing gear. The second turn unlocks the gear doors. The final turn unlocks the gear, allowing the gear to extend by gravity. Down locking is assisted by locking springs for the main gear and aerodynamic forces for the nose gear. The gear doors remain open.

It is possible to restore normal landing gear operation by winding the gravity extension handle counter clockwise and stowing it if green hydraulic pressure is available.

Nosewheel Steering

Overview

Nosewheel steering is electrically controlled through a dual channel Brake and Steering Control Unit (BSCU). The BSCU processes pilot or autopilot commands to provide nosewheel steering. The BSCU is activated by placing the A/SKID & N/W STRG switch to ON. The nosewheel steering actuating cylinder receives hydraulic pressure and fluid from the Green hydraulic system.

There is no mechanical connection between the nosewheel and the controls available for steering. The controls used for steering are the:

- steering handwheels,
- rudder pedals, and
- autopilot (to track the localizer during an autolanding).

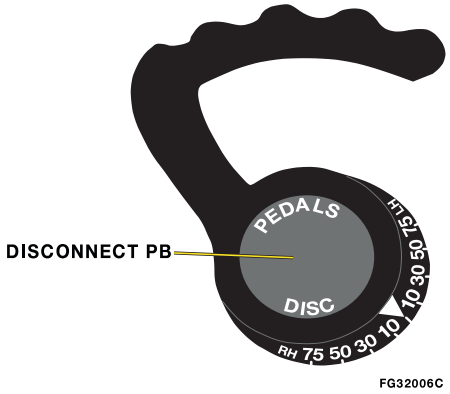
Nosewheel Steering (continued)

Steering Handwheels

Steering handwheels are located on each pilot's side console. They provide low speed directional control. The handwheels can command a nosewheel turn angle that corresponds to angles printed on the base of the hand wheels. The amount of steering available varies based on ground speed. Full authority, ± 75°, is available up to 20 kts and decreases at a constant rate to 0° at 70 kts.

Handwheels are connected electrically through the BSCU.

The handwheels move independently. If an input is made on both handwheels simultaneously, the combined input is summed and sent as a command to the BSCU. For example, if one handwheel is moved full left and the other full right, the sum of their inputs is zero and the nosewheel will remain centered. However, the summed steering angle can never exceed the highest angle printed at the base of a handwheel.



A pushbutton in the center of the handwheel allows the rudder pedals to be disconnected from nosewheel steering. This allows the pilot to check the rudder travel without turning the nosewheel while taxiing.

Nosewheel Steering (continued)

Rudder Pedal

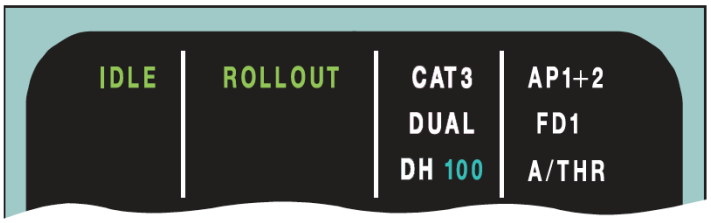
The captain or first officer rudder pedals provide limited nosewheel steering. The amount of steering available varies based on ground speed. Full authority, ± 6°, is available up to 40 kts and decreases at a constant rate to 0° at 130 kts.

Nosewheel Steering (continued)

Autopilot

The autopilot provides nosewheel steering control during autoland rollouts. The autopilot must be disconnected prior to taxiing off the runway center line.

The FMA messages, “ROLLOUT” and “AP1”, “AP2”, or “AP 1 + 2” on the Flight Mode Annunciator indicate that the autopilot is controlling the nosewheel steering.



DALFG58007C

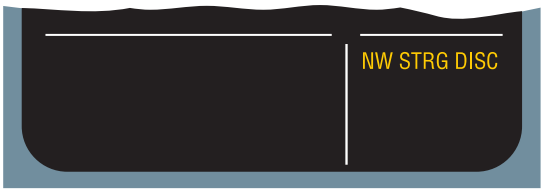
Caution: *Significant steering handwheel or rudder pedal inputs can disconnect the autopilot.*

Towing Control Lever

The Towing Control Lever is located on the Nose Wheel Electrical Box which is attached to the nose landing gear strut. It is used by ground personnel when greater turning angles are required, such as is the case when the aircraft is being towed or during pushback.

When the lever is placed in the TOW position, nosewheel steering capability from the flightdeck controls is inhibited. An ECAM memo message NW STRG DISC appears in green to alert the crew. The message turns amber when at least one engine is operating.

Nosewheel disconnected by the Towing Control Lever



Nosewheel disconnected by the Towing Control Lever and at least one engine running

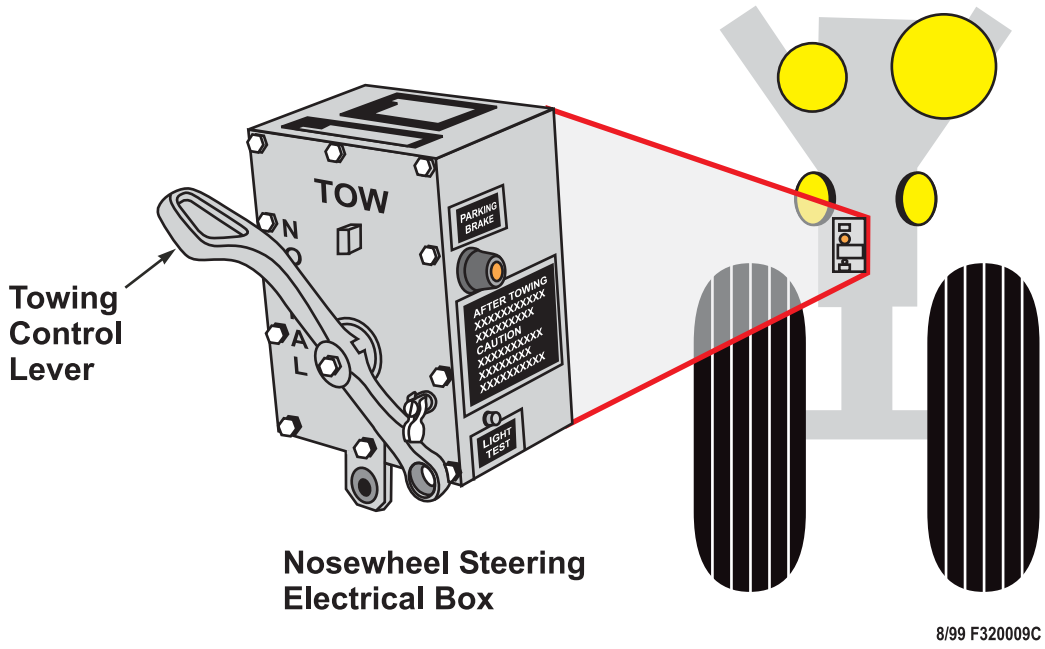
F320063C

Note: The NW STRG DISC message is not associated with the A/SKID & N/W STRG switch.

When the lever is returned to the NORMAL position, nosewheel steering capability is returned to the flightdeck controls and, the ECAM message is removed.

Nosewheel Steering (continued)

Towing Control Lever (cont.)



Nose Steering Availability

Nosewheel steering is available when:

- the A/SKID & N/W STRG switch is in the ON position.
- at least one engine is running,
- the Towing Control Lever is in the normal position,
- aircraft ground speed is less than 130 kts (rudder pedals) or 70 kts (handwheel),
- the aircraft is on the ground, and
- the Green hydraulic system is pressurized.

Note: Nosewheel steering is not available when the nose gear doors are open, as is the case when the gear have been manually extended.

Nosewheel Centering

An internal centering cam within the nose gear strut returns the nose gear to a centered position after takeoff. Centering can only take place after the nose gear strut has extended.

Main Wheel Brakes

Description

The main wheels are equipped with carbon multi-disc brakes which can be actuated by either of two independent systems.

The normal system uses Green hydraulic pressure, and the alternate system uses the Yellow hydraulic system, backed up by a hydraulic accumulator.

An anti-skid and autobrake system is also provided.

The main gear wheels are fitted with fusible plugs which protect against tire burst in the event of overheat. Each brake also has two wear pin indicators.

Brake temperatures are indicated on the ECAM WHEEL system display page.

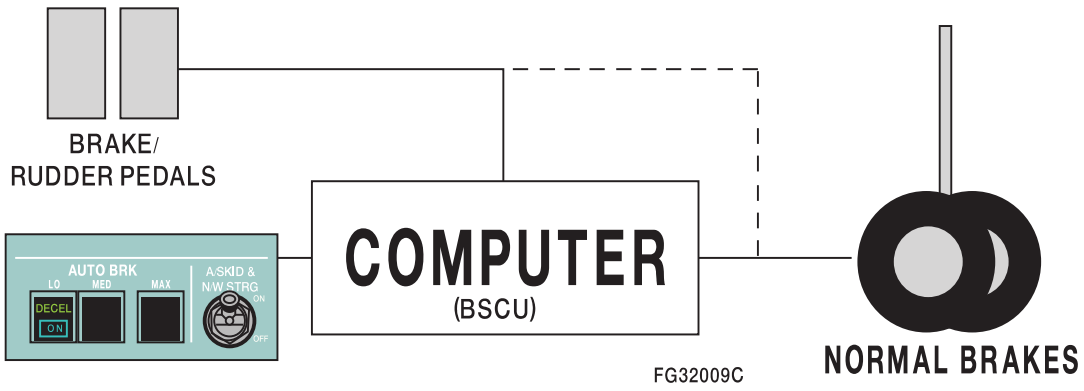
There are four modes of braking operation:

- normal with anti-skid,
- alternate with anti-skid,
- alternate without anti-skid,
- accumulator, and
- parking brake.

Brake Control

Braking commands come from brake pedals (pilot action) or the autobrake system (deceleration rate selected by the crew).

Control of all braking functions is provided by a two channel Brake and Steering Control Unit (BSCU).



The BSCU provides control for the:

- normal and alternate braking,
- anti-skid control,
- autobraking, and
- brake temperature indication for the ECAM WHEEL page.

Main Wheel Brakes (continued)

Brake Temperature Monitoring

Temperature sensors are installed in each main wheel brake. These sensors send the temperature value to the ECAM for display on the ECAM WHEEL page.

FG32010C

The maximum brake temperature for takeoff is 300°C.

See the Vol. 1, L.10and the QRH for additional brake temperature information.

Note: Unusually high brake temperatures can indicate a dragging or binding brake. Unusually low brake temperatures can indicate an inoperative brake. In either case, notify maintenance.

Normal and Alternate Braking

Normal Braking

The Normal Braking system is automatically selected and available when:

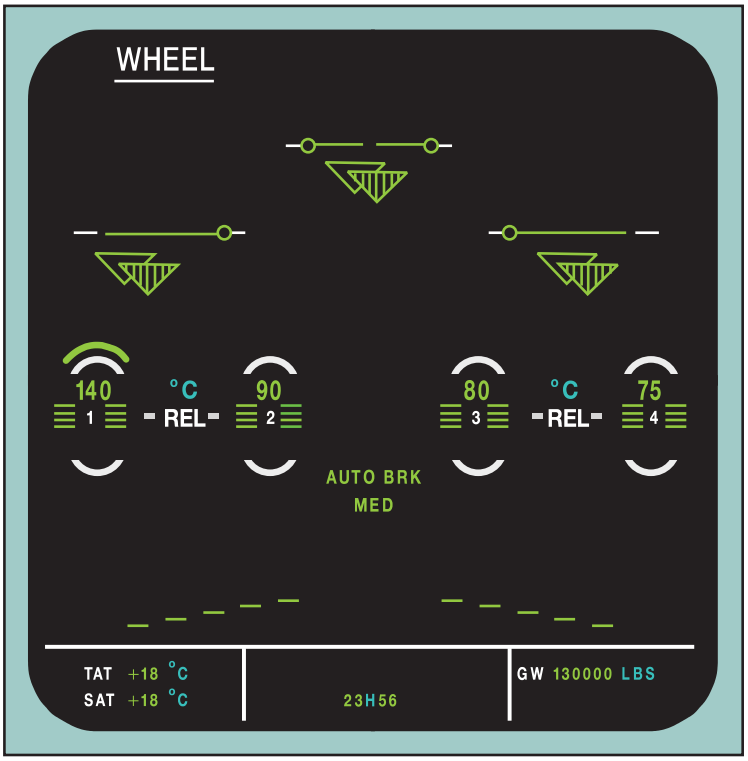
- Green hydraulic system pressure is available,
- the A/SKID & N/W STRG switch is selected ON and Anti-skid is operative.
- Parking Brake is selected OFF.

Normal and Alternate Braking (continued)

Normal Braking (continued)

Normal brake hydraulic pressure is controlled electrically by the BSCU. Normal braking can be applied manually by depressing either set of rudder pedals, or automatically through the Auto Brake system.

Caution: *Other than auto brake system status, there are no direct indications of Normal Brake system hydraulic pressure or application on the ECAM WHEEL page.*



FG32014C

Note: When the landing gear lever is selected to the UP position, hydraulic pressure is automatically applied to the main landing gear wheel brakes.

Normal and Alternate Braking (Continued)

Alternate Braking with Anti-Skid

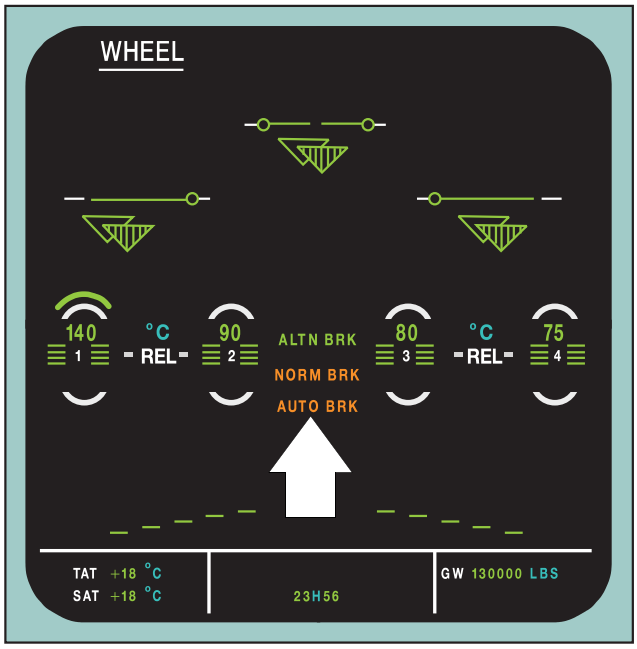
Alternate braking with anti-skid capability is automatically selected when the Green Hydraulic system pressure is insufficient, provided:

- Yellow hydraulic pressure is available,
- A/SKID & N/W STRG switch is in the ON position, and
- the parking brake is OFF.

Normal and Alternate Braking (continued)

Alternate Braking with Anti-Skid (continued)

The ECAM WHEEL system display page indicates the alternate system braking is in operating.

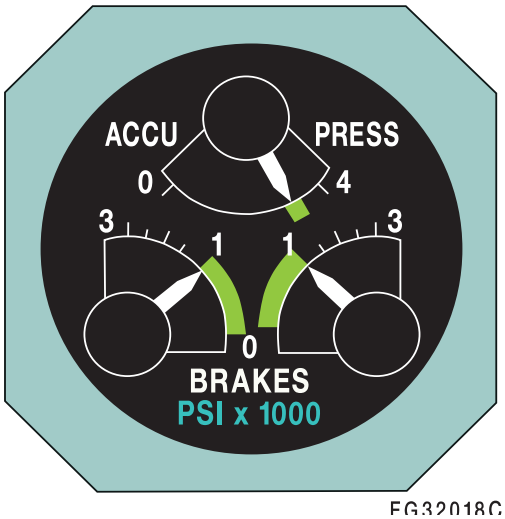


FG32017C

FG32016C

Depressing the rudder pedals operates a dual valve which allows Yellow hydraulic system pressure to be applied to the brakes. Yellow hydraulic system pressure delivered to left and right brakes, as well as Yellow hydraulic system accumulator pressure, are depicted on the ACCU-PRESS/BRAKES gauge located on the center instrument panel.

The ACCU-PRESS/BRAKES gauge is show below.



FG32018C

Normal and Alternate Braking (continued)

Alternate Braking with Anti-Skid (continued)

Anti-skid is still available as long as Yellow hydraulic system pressure remains. Autobrakes are inoperative when using alternate braking.

Normal and Alternate Braking (continued)

Alternate Braking without Anti-Skid

Alternate braking control is achieved by manually depressing the brake pedals. When in the alternate braking mode, the anti-skid will be operational unless:

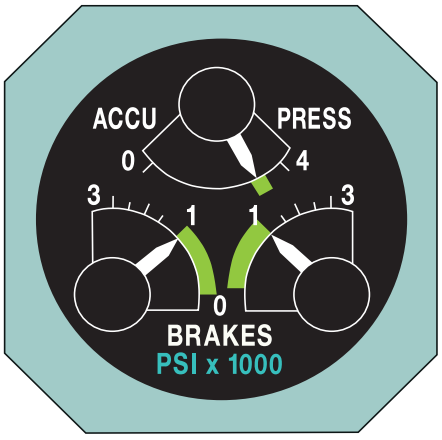
- the A/SKID and N/W STRG switch is OFF or power to the switch has failed,
- the BSCU has failed, or
- both Yellow and Green hydraulic systems have low pressure.

Yellow hydraulic accumulator pressure backs up Yellow and Green hydraulic system low pressure.

Note: When Yellow hydraulic accumulator pressure is all that remains, a maximum of 7 full brake applications can be applied before the accumulator is depressurized.

Without anti-skid, brake pressure must be limited by referencing the ACCU-PRESS/ BRAKES gauge.

The following diagram illustrates the ACCU-PRESS/BRAKES gauge which shows Yellow hydraulic system pressure delivered to the left and right main gear brakes and Yellow hydraulic system accumulator pressure.



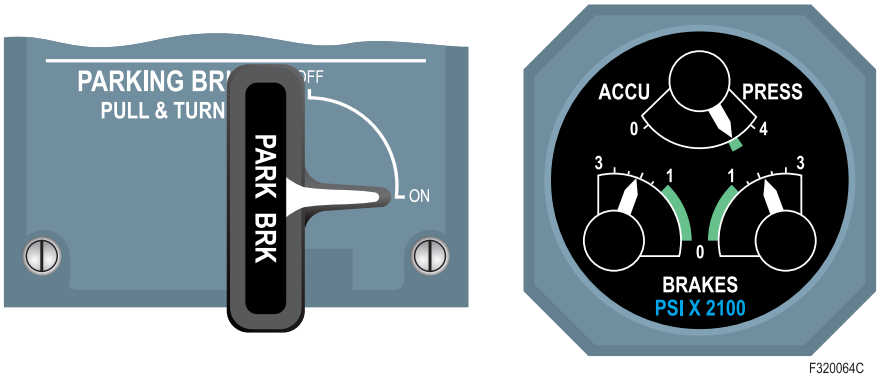
FG32018C

Parking Brake

Description

The aircraft's parking brake is applied by placing the Parking Brake control handle, located on the aft portion of the center pedestal, to the ON position. Conversely, placing the handle to the OFF position deactivates the parking brake. Brake pedal depression is not required when selecting or deselecting the parking brake.

Caution: *Activating the Parking Brake will result in an immediate main gear wheel lock up. Ensure that the aircraft is fully stopped before applying the Parking Brake.*



Note: Activating the parking brake will cause the automatic deactivation of the Normal and Alternate Brake systems.

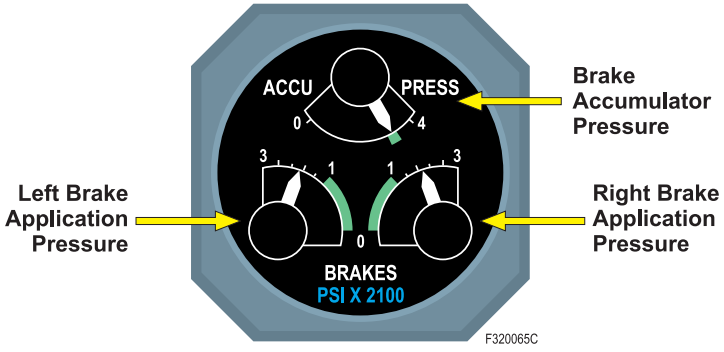
Parking Brake Application Pressure

Hydraulic pressure for the parking brake system is normally supplied by the Yellow hydraulic system. When the Yellow hydraulic system is not operating, a Yellow system accumulator will provide the required application pressure for the Parking Brake.

Note: With an inoperative Yellow hydraulic system, a fully charged accumulator is capable of keeping the parking brake set for several hours. However, the accumulator's pressure will eventually bleed-off.

The ACCU-PRESS/BRAKES gauge, located on the forward instrument panel, displays accumulator pressure (ACCU PRESS) and Left/Right brake application pressure (BRAKES).

Note: The application pressure indicators only display pressure provided by the Alternate Brake system or the Parking Brake. They do not function when the Normal Brake system is being utilized.



Parking Brake (continued)

Parking Brake ON Indications

There are several indications associated with parking brake activation. They include:

- A message displayed on the ECAM MEMO section:

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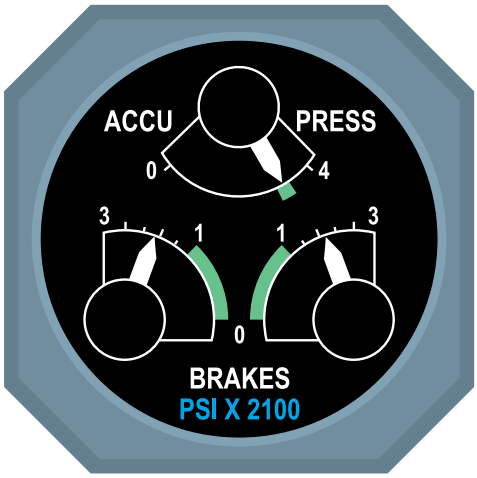
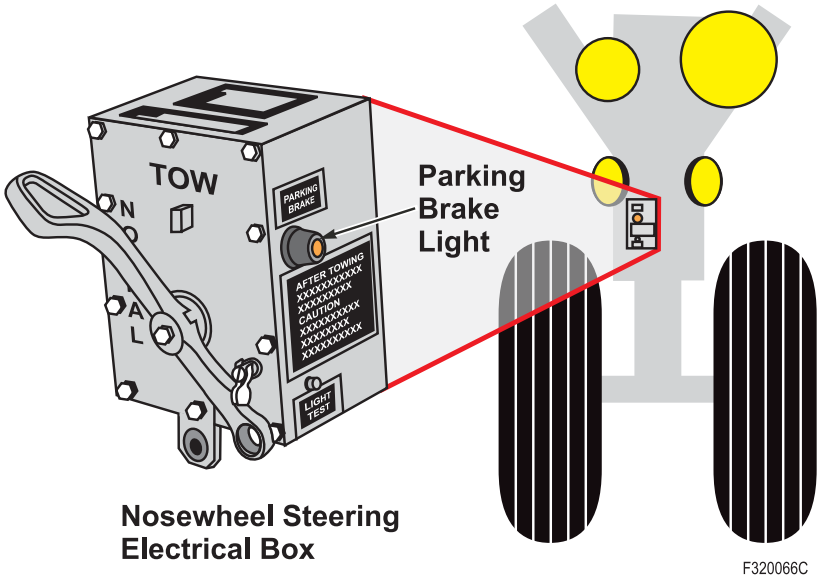
F320023C

- Indication of pressure on the ACCU-PRESS/BRAKES gauge:



F320025C

- An illuminated PARKING BRAKE light, located on the Nose Wheel Electrical Box:



F320066C

Note: Do not apply thrust on both engines in excess of 75% N1 with the parking brake ON.

Anti-Skid

Description

The anti-skid system provides maximum braking efficiency by maintaining wheel braking to the limit of an impending skid.

When wheel skid is detected, a release signal is sent to the normal and alternate brake servo valves. Additionally this release signal is sent to the ECAM where it is displayed on the ECAM WHEEL page to indicate brake release.

FG32010C

Anti-skid is always available with normal braking. When using alternate braking, anti-skid may or may not be available depending on the condition of the Yellow hydraulic system and the BSCU.

When the alternate system is in use and low Yellow hydraulic system pressure is detected, the BSCU will deactivate anti-skid. Anti-skid is also shut off if an electrical power failure occurs to the BSCU.

Autobrakes

Description

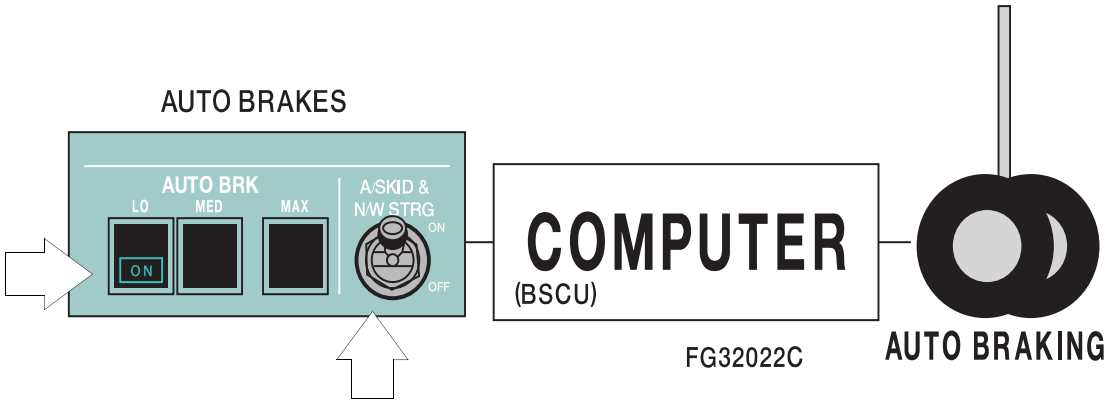
An autobrake system is installed to reduce braking distance in the event of an aborted takeoff and to establish and maintain a pilot selected deceleration rate during landing.

Arming

The autobrake system is armed by selecting the LO, MED or MAX pb on the autobrake control panel. In order for arming to take place, the following must be true:

- Green hydraulic system pressure is available,
- the A/SKID & N/W STRG switch must be in the ON position,
- there is no failure in the braking system, and
- at least one ADIRS is functioning.

Note: Autobrakes can be armed with the parking brake ON.

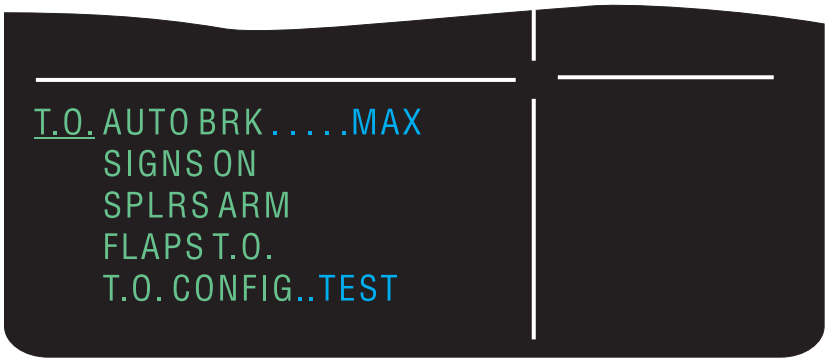


Autobrakes (continued)

Autobrake Activation

Autobraking is initiated by the ground spoiler extension signal.

After engine start, the ECAM MEMO section displays an AUTO BRK message as part of the takeoff checklist. It appears blue until the action has been taken.



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Note: If a takeoff is aborted below 72 kts, autobraking will not be operative since an extension signal to the ground spoilers cannot be generated below this speed.

Autobrake Disarming

The pilot can disarm autobrakes by:

- sufficient force on **either** brake pedal or,
- pressing the illuminated armed pb on the AUTO BRK panel,

Autobrakes are automatically disarmed by:

- loss of one or more arming conditions,
- ground spoiler retraction, or
- after takeoff, aircraft being airborne for more than a few seconds.

Controls and Indicators

Location of Controls and Indicators

Introduction

Controls and indicators associated with the Landing Gear system are located throughout the flight deck.

Location

The Landing Gear system controls and indicators are located as shown below

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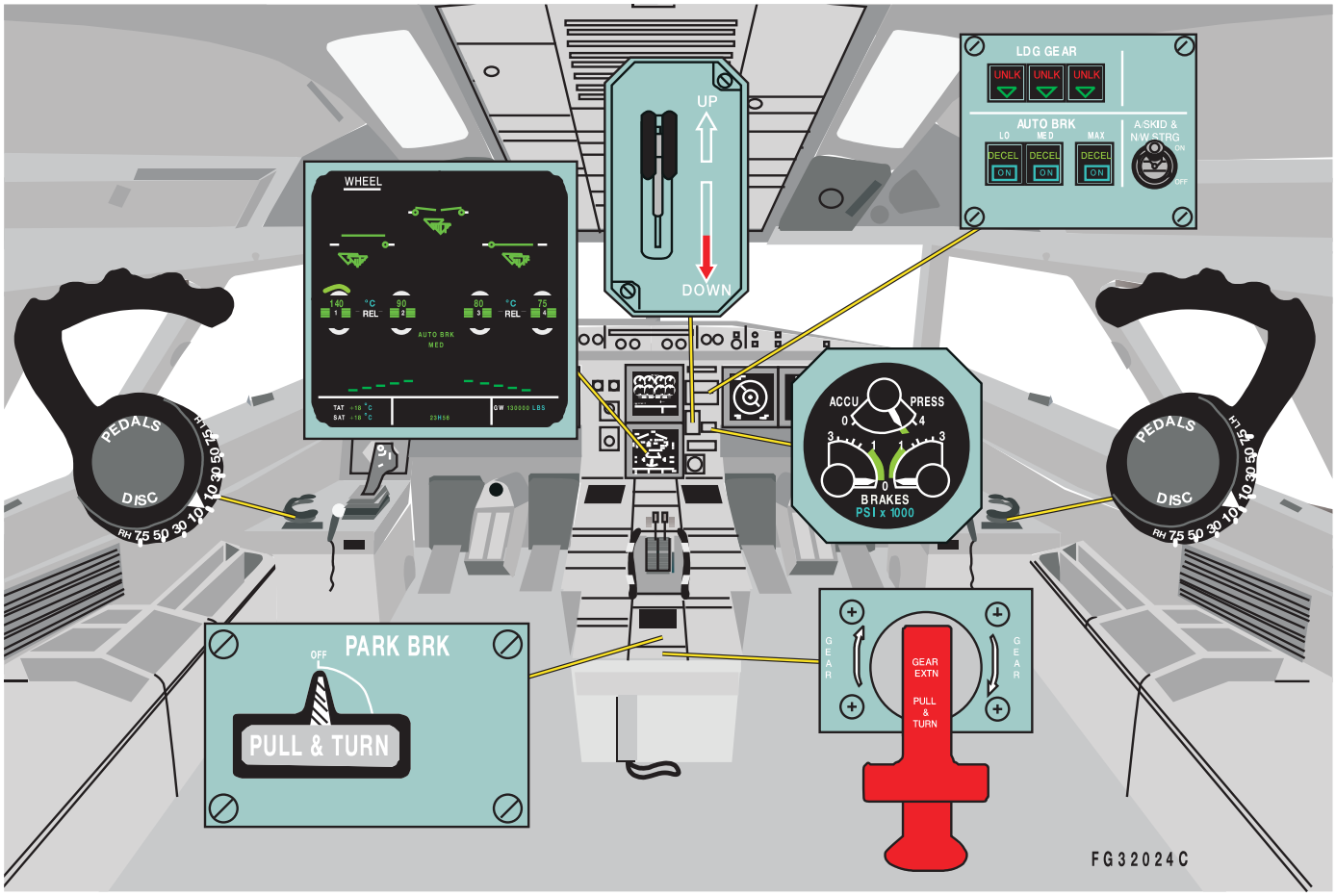


ECAM WHEEL Page

Introduction

The ECAM WHEEL page displays indications for the following systems:

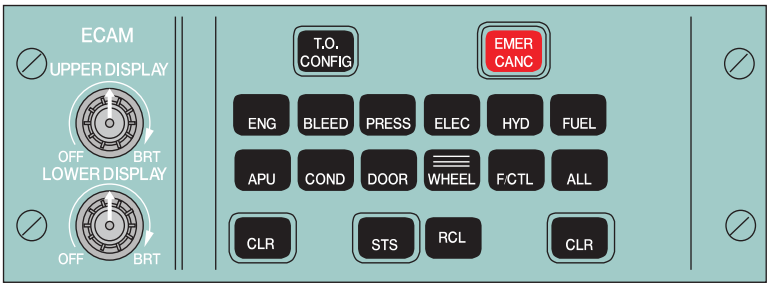
- landing gear,
- brakes, and
- anti-skid.

The ECAM WHEEL page automatically appears:

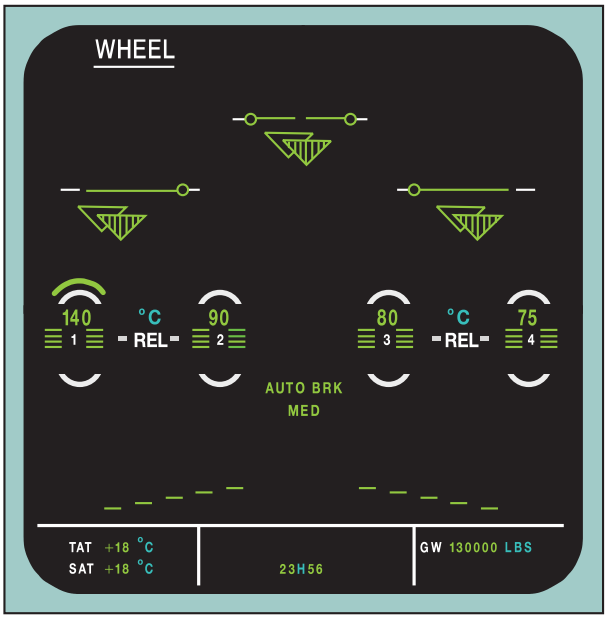
- on the ground, with an engine running prior to applying takeoff power;
- in flight, when the landing gear is selected down;
- for certain landing gear and brake malfunctions, and
- for all nosewheel steering malfunctions.

The ECAM WHEEL page can be manually selected with the WHEEL pb on the ECAM control panel, located on the pedestal.

Landing Gear Indications



FG32025C



FG32014C

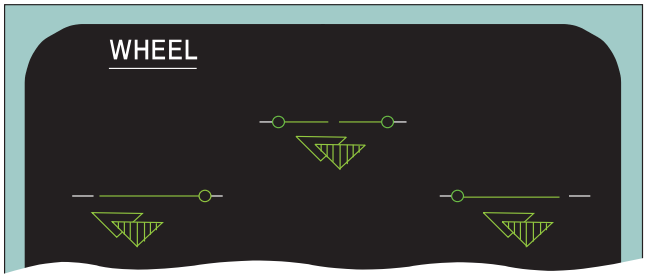
ECAM WHEEL Page (continued)

Triangles

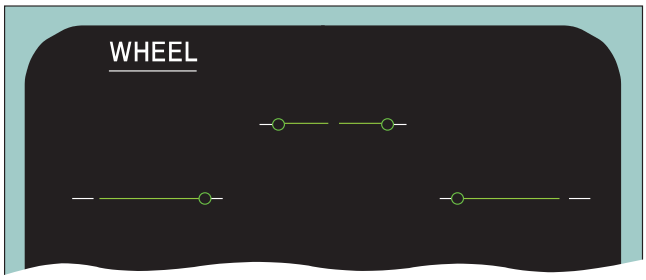
A pair of triangles represents each landing gear. When the landing gear is up, no triangles are displayed.

Each triangle within the pair represents one of the Landing Gear and Control Interface Unit's (LGCIU) interpretation of that landing gear's position.

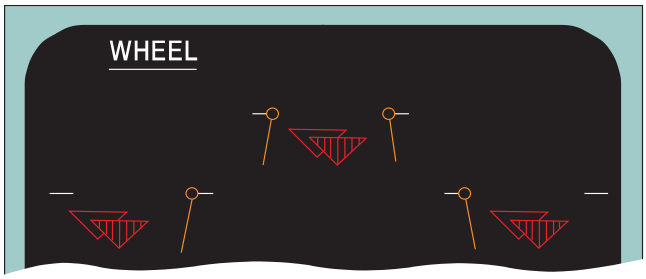
Landing Gear Down



Landing Gear Up



Landing Gear In Transit



LGCIU Fault Unable to Detect Gear or Door Position

FG32026C

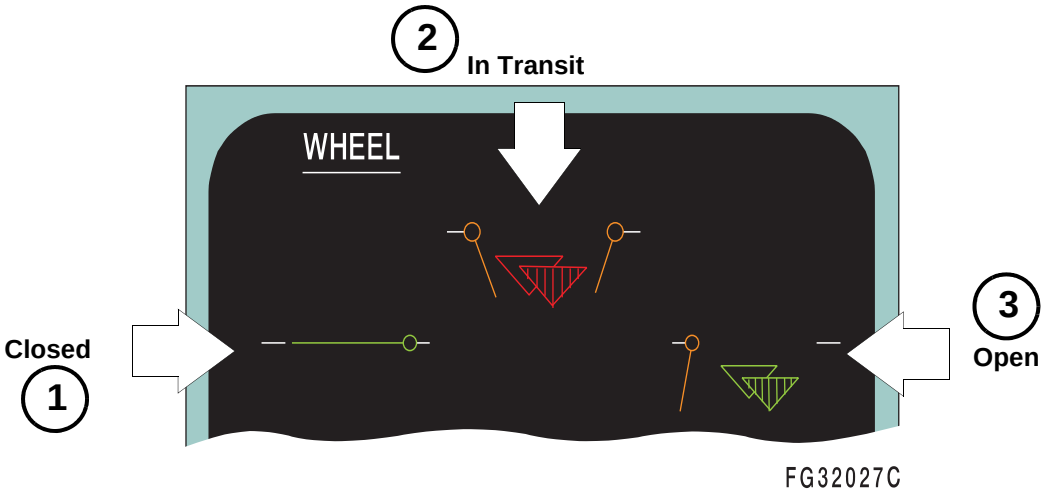
A red triangle(s) indicates a landing gear in transit condition.

A green triangle(s) indicates a landing gear down and locked condition.

An amber triangle(s) with double “X”s indicates a fault in one of the LGCIUs.

ECAM WHEEL Page (continued)

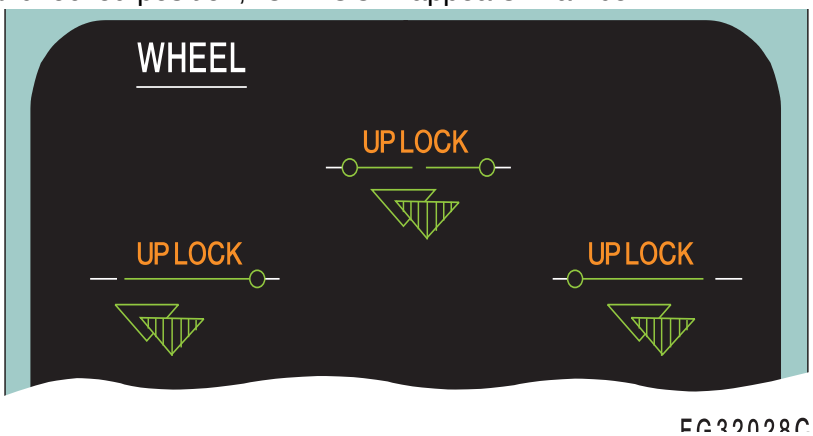
L/G Doors Indications



1. This indication appears in green when the gear door is closed.
2. This indication appears in amber when the gear door is in transit.
3. This indication appears in amber when the gear door is fully open. This would be an abnormal situation (e.g., after emergency gear extension).

UP LOCK Indication

If any of the landing gear up locks are engaged, and its associated landing gear is in the down and locked position, “UP LOCK” appears in amber.

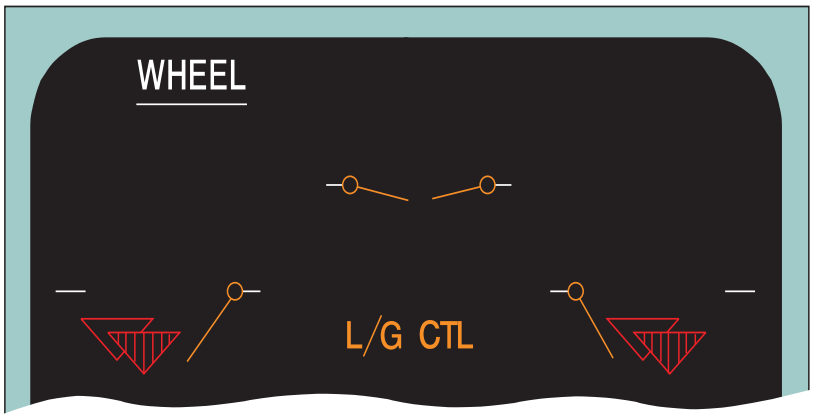


Note: When the UP LOCK words appear, do not retract the landing gear.

ECAM WHEEL Page (continued)

L/G CTL Indication

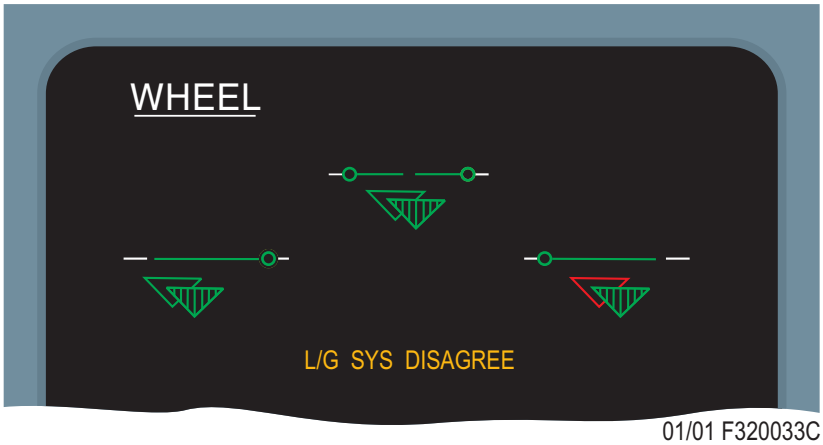
If any landing gear are in a different position than that selected by the landing gear lever, the message “L/G CTL” will appear on the ECAM WHEEL page. This indication is normally seen while the landing gear is in transit.



FG32029C

L/G SYS DISAGREE

The ECAM system compares the L/G (gear only) position data from LGCIU 1 with LGCIU 2. When there is a difference between those sources of data (e.g., due to a proximity sensor failure) it will display the message “L/G SYS DISAGREE” on the ECAM WHEEL page.



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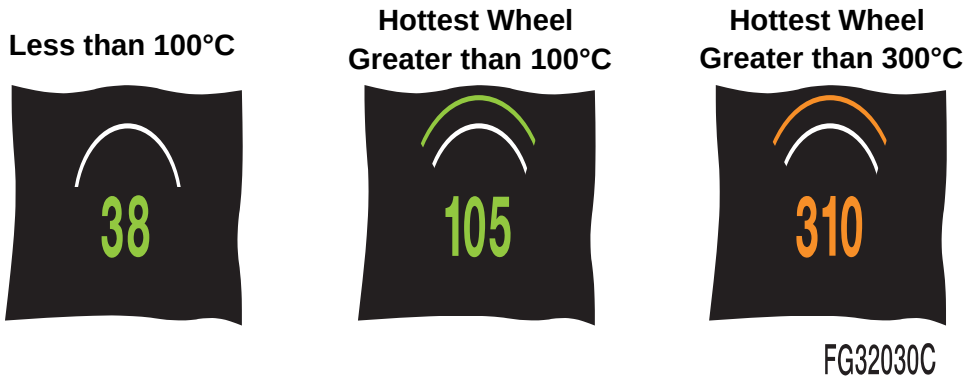
ECAM WHEEL Page (continued)

Temperature Indications

1. Brake temperatures appear in degrees Celsius. Green values are in the normal range. Amber values are displayed for temperatures above 300°C.
2. Green Arc
   A green arc appears over the hottest wheel when the brake temperature is between 100°C and 300°C.
3. Amber Arc
   An amber arc appears over the hottest wheel when its brake temperature is above 300°C.

Caution: *Do not takeoff with any brake temperature in excess of 300°C.*



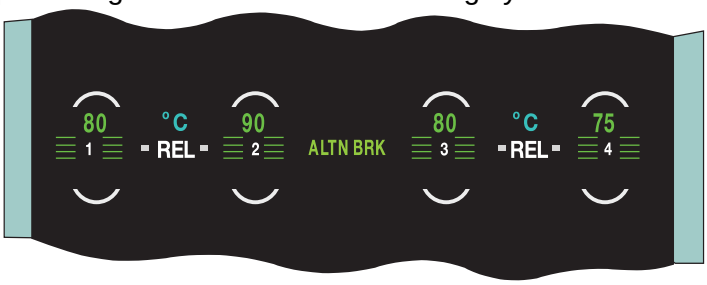
A/SKID

"A/SKID" appears in amber when the A/SKID & NW STRG switch is selected OFF, or a failure occurs in both channels of the BSCU.

ECAM WHEEL Page (continued)

ALTN BRK

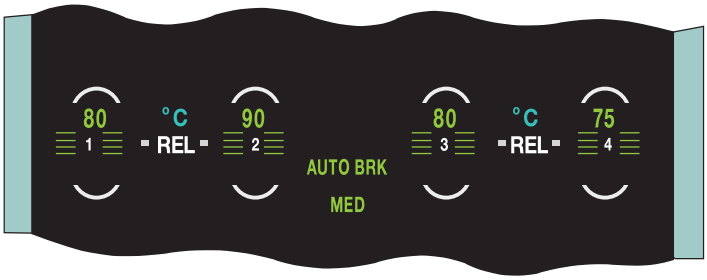
"ALTN BRK" appears in green if the alternate braking system is activated.



FG32032C

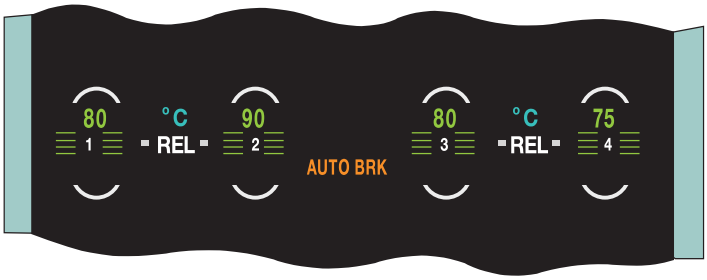
AUTO BRK

"AUTO BRK" appears in green when an autobrake selection is made.



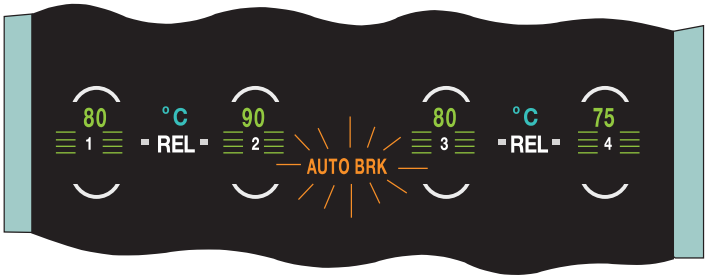
FG32033C

"AUTO BRK" appears in amber if the system is armed or being armed with a fault in the autobrake system.



FG32034C

"AUTO BRK" flashes for several seconds and then disappears when the autobrakes are disengaged.

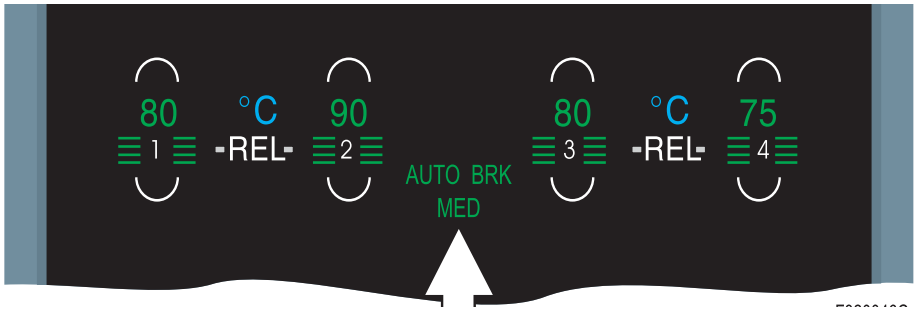


FG32035C

ECAM WHEEL Page (continued)

LOW, MED, MAX

These indications appear in green below “AUTO BRK,” showing the pilot selected deceleration rate.

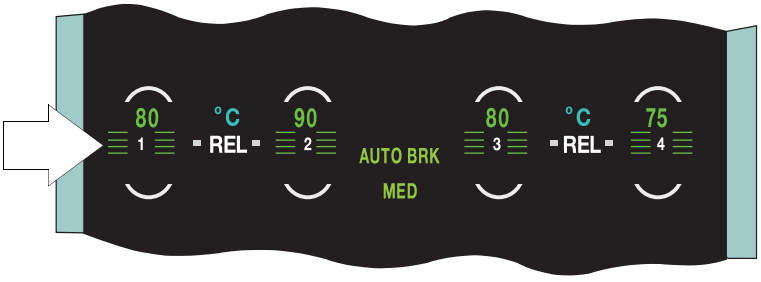


Anti-Skid Indications

Horizontal green bars represent the anti-skid system of each respective wheel brake. They appear:

- in flight, momentarily after the landing gear has been lowered, to indicate that the associated wheel brake is released and the anti-skid function is armed.
- on the ground, when the associated anti-skid is functioning.

Note: Wheel numbers 1, 2, 3, 4, and the letters REL are continuously in view.



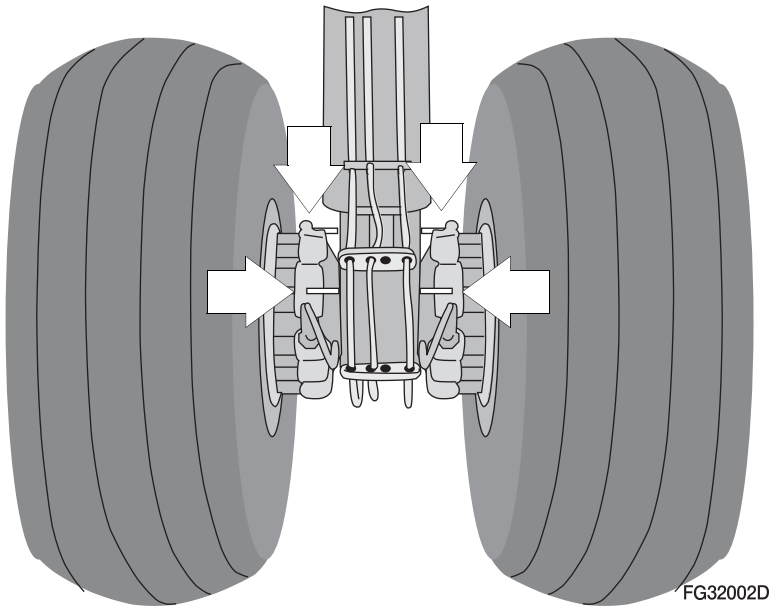
FG32036C

ECAM WHEEL Page (continued)

Brake Wear Pins

Two brake wear indicator pins are installed on each main wheel assembly.

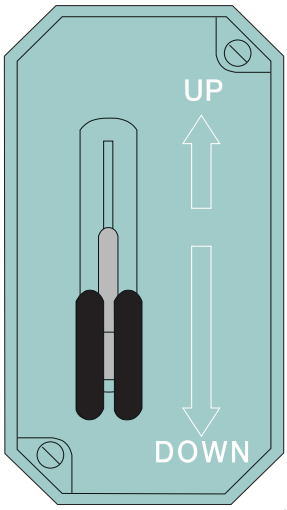
With the parking brake ON, the brake wear pin must extend beyond the housing.



Landing Gear Lever

Function

The landing gear lever controls the raising and lowering of the landing gear. It is located on the forward instrument panel on the right side of the ECAM displays.



FG32038C

UP

The following actions take place when the landing gear lever is selected UP in flight, with Green hydraulic pressure available:

- the landing gear doors open,
- the landing gear retracts,
- the landing gear up locks engage, and
- the landing gear doors close.

Note: When the main or nose landing gear strut(s) is not extended, or the nose wheel is not centered, the landing gear lever is locked in the down position.

Landing Gear Lever (continued)

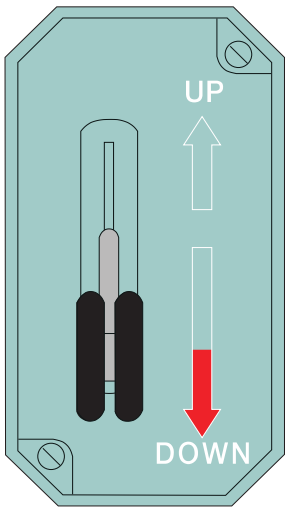
DOWN

The following actions take place when the landing gear lever is selected DOWN in flight, with Green hydraulic pressure available:

- the landing gear doors open,
- the landing gear up locks release,
- the landing gear extends, and
- the landing gear doors close.

Red Down Arrow

UP and DOWN arrows are located to the right of the landing gear lever. The DOWN arrow will illuminate red if the landing gear is not down and locked below a safe altitude during approach.



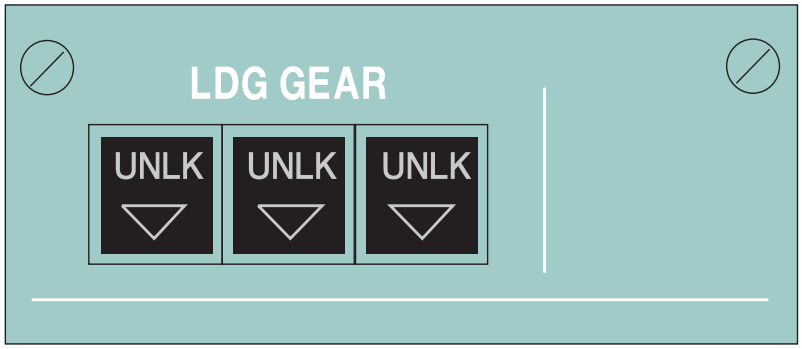
FG32039C

Note: Refer to WARNINGS/CAUTIONS MESSAGES section for additional information.

Landing Gear Indicator Panel

Panel

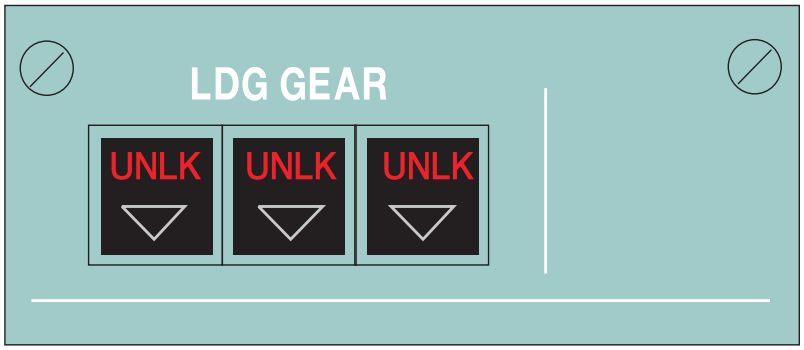
The diagram below illustrates the LDG GEAR indicating panel. It is located on the forward instrument panel above the landing gear lever.



FG32040C

UNLK

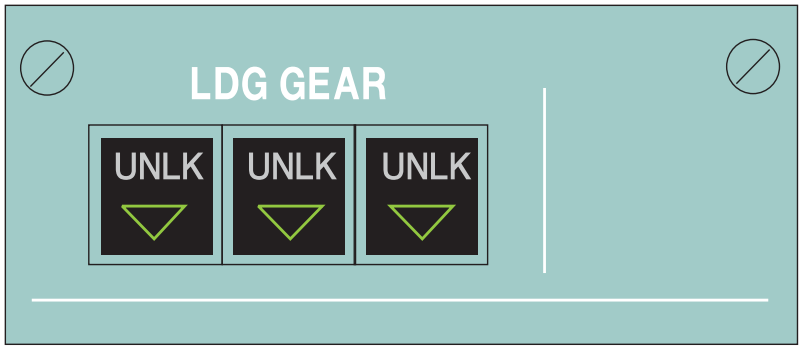
The “UNLK” lights illuminate red when gear is not in the selected position. This illumination is most commonly seen when the landing gear is in transit.



FG32041C

Down & Locked Indication

The downward pointing triangles illuminate green when LGCIU 1 detects that the landing gear is down and locked.



FG32042C

Landing Gear Indicator Panel (continued)

E/WD MEMO Section

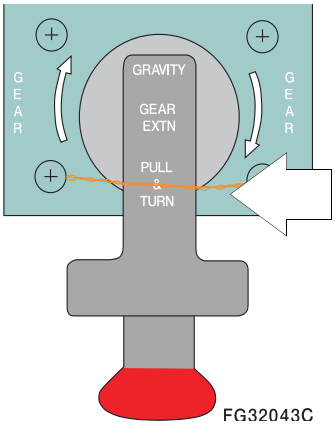
Landing gear and brake system warnings or malfunctions will normally appear as a memo message on the ECAM Engine and Warning Display (E/WD).

FG32037C

Gravity Extension Handle

Function

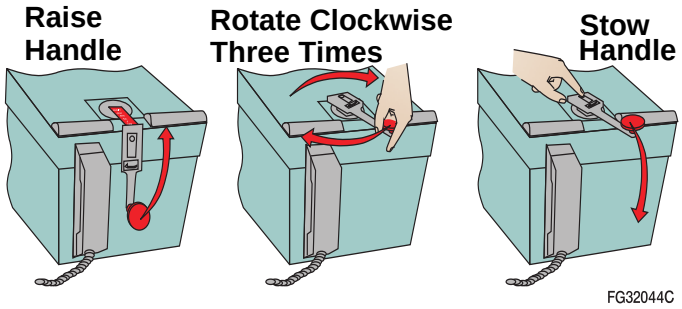
The landing gear GRAVITY GEAR EXTN hand crank controls extension of the landing gear in the event that normal extension is not available.



Operation

The following actions occur when the red knob of the gravity extension hand crank is lifted (breaking the safety wire) and turned clockwise three times:

- hydraulic pressure to the landing gear system is cut off,
- the landing gear doors open,
- landing gear up locks are released,
- landing gear free falls to the extended position.



The landing gear lever does not have to be in the down position to gravity extend the landing gear. However, in order to receive a correct down and locked indication (no red UNLK lights) on the landing gear indicator panel, the landing gear lever must be selected to the down position.

With the gravity extension of the landing gear, the gear doors remain open. As such, nose wheel steering will be inoperative upon landing.

Caution: *To avoid further damage, the flight crew will not attempt to reset the Gravity Extension hand crank in order to regain nose wheel steering capability.*

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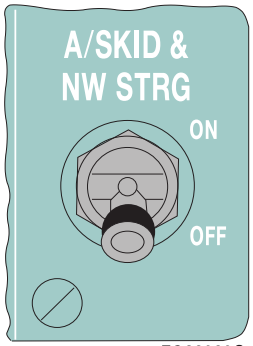
A/SKID & N/W STRG Switch

Function

The A/SKID & N/W STRG switch controls power to the BSCU. It is located on the forward instrument panel adjacent to the landing gear indicator panel.



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ON

When the A/SKID & N/W STRG switch is selected ON, power is provided to the BSCU for actuation of the nosewheel steering when:

- handwheel inputs are made, or
- rudder pedal inputs are made, providing the PEDALS DISC button on the handwheel is not depressed.

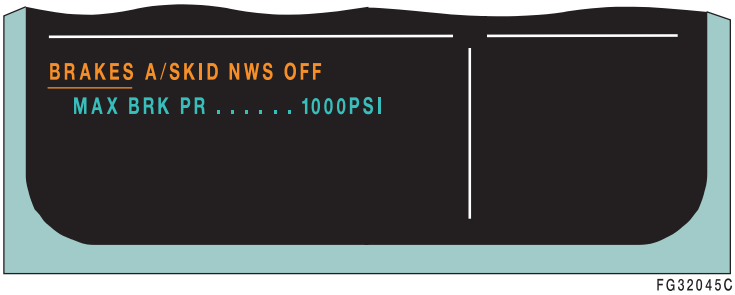
OFF

When the A/SKID & N/W STRG switch is selected OFF:

- power is removed from the BSCU,
- nosewheel steering is inhibited,
- the anti-skid system is disabled.

Since this action disables both anti-skid and nosewheel steering systems, the following also occurs when the switch is selected OFF:

- the MSTR CAUT light illuminates amber,
- a single chime sounds,
- the ECAM WHEEL page is automatically displayed,
- a memo message appears on the ECAM E/WD, and
- normal braking (Green) is inoperative.



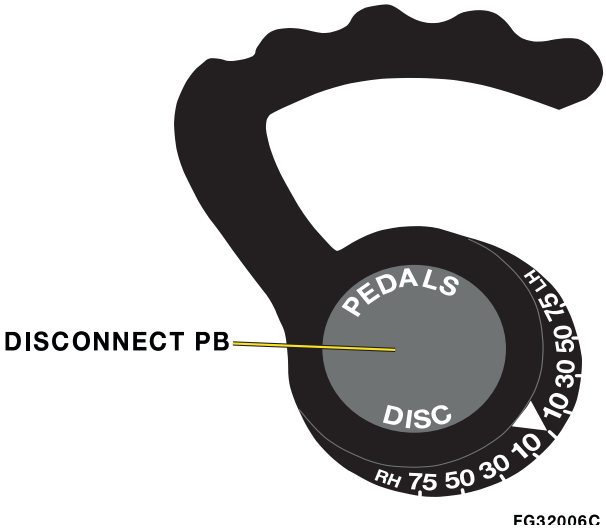
FG32045C

Steering Handwheel

Function

A handwheel is located on each outboard side of the flight deck.

Turning the handwheel left or right causes the nosewheel to turn to the angle indicated on the base of the handwheel. A maximum nose wheel angle of 75° left or right of center can be obtained using the handwheel.



Pedal Disc Button

Depressing the PEDALS DISC button in the center of a handwheel disconnects nosewheel steering from the rudder pedals. This allows a flight control rudder check without affecting nosewheel steering.

Rudder Pedals

Rudder Pedal Steering

Nosewheel steering (up to 6° left and right of center) is available by pilot movement of the rudder pedals.

ACCU-PRESS/BRAKES Gauge

Function

The ACCU-PRESS/BRAKES gauge displays yellow accumulator pressure and pressure provided to the brakes by the Yellow hydraulic system or its accumulator. It is located on the front instrument panel adjacent to the landing gear lever.

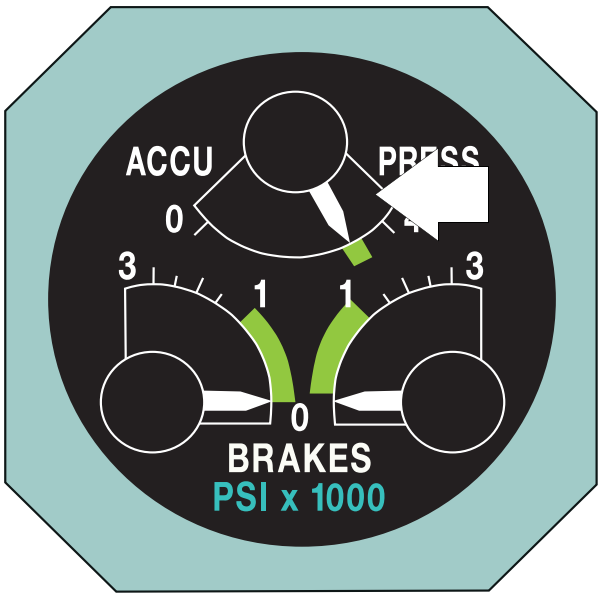
ACCU PRESS Indication

The pressure reading on the top portion of the indicator reflects Yellow hydraulic system accumulator pressure.

A pressure reading in or near the green band indicates a fully charged accumulator.

With a fully charged accumulator the parking brake can be set and will provide holding power for several hours.

An ACCU PRESS reading will be available anytime the accumulator is charged, regardless of Green or Yellow hydraulic system status.



FG32015C

ACCU-PRESS/BRAKES Gauge (continued)

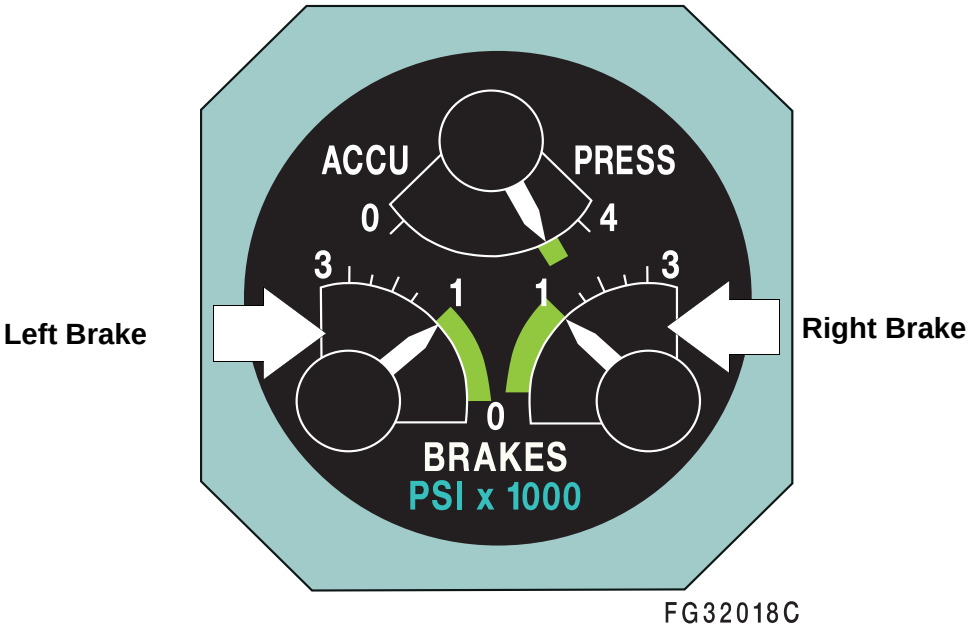
BRAKES Indication

When Yellow system hydraulic pressure (either by pump or accumulator) is being used by the brake system, the pressure applied at the left and right main wheel brakes is displayed on the lower portion of the gauge.

If using alternate braking (Yellow system hydraulic pressure in use) and anti-skid is inoperative, a pressure reading in the green band must be maintained by manually depressing and modulating the brake pedals.

In normal braking, Green system hydraulic pressure provides pressure to the brakes. As such, a BRAKES pressure indication on the ACCU-PRESS/BRAKES indicator would be 0 PSI.

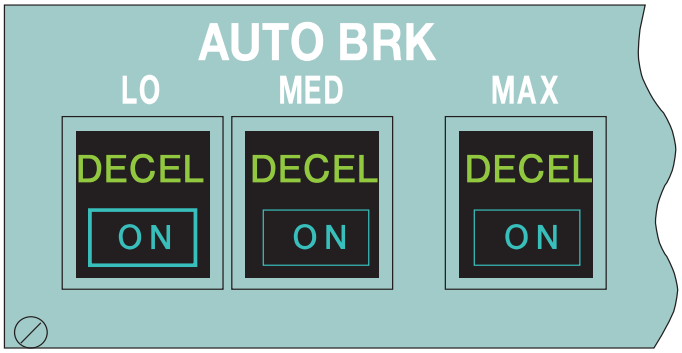
The following diagram illustrates Yellow system hydraulic pressure being applied to the left and right main wheel brakes.



Autobrake Panel

Function

The AUTO BRK control panel pbs are used to select the desired rate of deceleration. It is located on the forward instrument panel.



FG32048C

Autobrake selections

LO: LO mode sends progressive pressure to the brakes 4 seconds after the ground spoilers deploy in order to decelerate the aircraft at 5.6 feet/second.

MED: MED mode sends progressive pressure to the brakes 2 seconds after the ground spoilers deploy in order to decelerate the aircraft at 9.8 feet/second.

Note: On some aircraft, as a result of a BSCU up grade, when LO or MED is selected, braking is progressively applied immediately following the spoiler deployment signal.

MAX: Braking is immediately applied when the spoiler deployment signal is triggered.

DECEL indication

A green DECEL light appears on the selected autobrake pb when the aircraft's deceleration is approaching the selected rate.

Note: On a slippery runway, the selected deceleration rate may not be reached due to antiskid system operation. In this case the respective DECEL light may not illuminate. This does not mean that the autobrake system is not functioning properly.

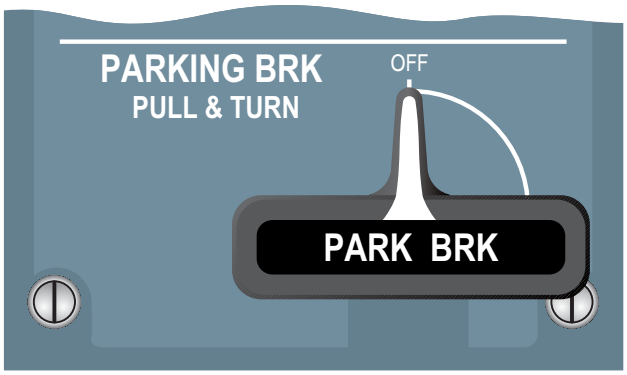
ON light

The ON light on an autobrake pb indicates the autobrake system is armed.

Parking Brake Handle

Function

The PARK BRK handle controls activation of the parking brake. It is located on the aft center pedestal.



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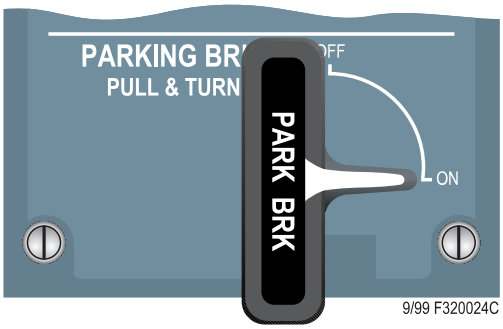
ON

To select the parking brake on, lift up the handle and rotate it clockwise to ON.

Verify that the parking brake is set by observing pressure on the ACCU-PRESS/ BRAKES indicator.



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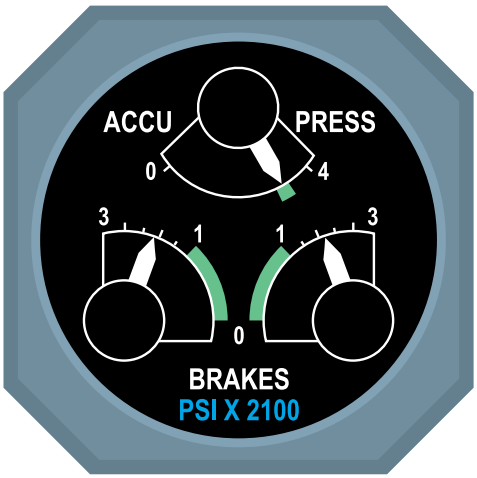

F320025C

With the engines not running, Yellow system accumulator pressure is normally used for setting the parking brake.

If Yellow system accumulator pressure is low, selecting the Yellow electric pump pb to “ON” will charge the accumulator, allowing parking brake to be set.

Warning/Caution Messages

Landing Gear

The following table lists the failures and associated messages and warnings that can occur in the landing gear system.

E/WD Failure Condition	Aural Warning	Master Light	System Page	Local Warning
GEAR NOT DOWN LOCKED One gear not down locked and L/G selected down.	CRC	Master Warning	None	None
GEAR NOT DOWN 1) L/G not down locked and radio height lower than 750 feet and both engines N_1 lower than 75% (or if engine shutdown N_1 of remaining engine lower than 97%), or 2) L/G not down locked and radio height lower than 750 feet and flaps at 3 , or FULL, or 3) L/G not down locked and flaps at 3, or FULL, and both radio altimeters failed. NOTE: In the case of 2 or 3 above, the aural warning can only be canceled by the EMER CANC pb.	CRC	Master Warning	None	DOWN ARROW lt on LDG GEAR panel
SHOCK ABSORBER FAULT One shock absorber not extended when airborne or not compressed after landing.	Single Chime	Master Caution	None	None
DOORS NOT CLOSED One gear door is not up locked.	Single Chime	Master Caution	WHEEL	None
GEAR NOT UP LOCKED One gear not up locked and L/G not selected down.	Single Chime	Master Caution	WHEEL	UNLK lt “ON”

Warning/Caution Messages (continued)

Landing Gear
(continued)

E/WD Failure Condition	Aural Warning	Master Light	System Page	Local Warning
GEAR UPLOCK FAULT One gear up lock engaged with corresponding gear down locked.	Single Chime	Master Caution	WHEEL	LDG GEAR panel
LGCIU 1 (2) FAULT	None	None	WHEEL	None
SYS DISAGREE Disagree between L/G positions detected by the two LGCIUs.	None	None	WHEEL	None

Nosewheel Steering

The following table lists the failures and associated messages and warnings that can occur in the nosewheel steering system.

E/WD Failure Condition	Aural Warning	Master Light	System Page	Local Warning
NW STEER FAULT Detected by BSCU.	None	None	WHEEL	None

Note: A memo message “NW STRG DISC” will appear in green on the E/WD when the nose wheel steering selector is in the towing position. The message becomes amber if one engine is running.

Warning/Caution Messages (continued)

Brakes

E/WD Failure Condition	Aural Warning	Master Light	System Page	Local Warning
CONFIG PARK BRK ON Parking brake is on when engine N_1 RPM exceeds a preset limit.	CRC	Master Warning	None	None
BRAKES HOT One brake temperature higher than 300°C.	Single Chime	Master Caution	WHEEL	None
AUTO BRK FAULT Failure of autobrake when armed.	Single Chime	Master Caution	WHEEL	None
ANTI SKID FAULT	Single Chime	Master Caution	WHEEL	None
ANTI SKID/NWS OFF Switch at OFF position.	Single Chime	Master Caution	WHEEL	None
RELEASE FAULT One release signal not present when in flight with L/G down locked.	Single Chime	Master Caution	WHEEL	None

Note: If the parking brake is ON a “PARK BRK” message will appear in the memo section of the E/WD.

Class II Failures

The following table lists Class II brake failures.

Message	Failure
BRAKES	BSCU channel A (B)

Chapter 33: Lighting

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Cabin Lighting 33.10.9
Exterior Lighting 33.10.10
Emergency Lighting 33.10.17
Cabin Signs 33.10.22
AVIONICS COMPT LT 33.10.24

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System Description

Flight Deck Lighting

Description

There are three types of flight deck lighting:

- general lighting
- specific area lighting (e.g., console, reading, pedestal, and flood)
- integral lighting for pbs and instrumentation

General Lighting

Two rectangular incandescent dome lights are used for general flight deck illumination. One is located above each pilot. A paddle switch on the overhead panel controls these lights, as shown below.

The right hand dome light provides emergency flight deck lighting when in the emergency electrical or battery only configuration. The aircraft batteries directly power this light in the emergency electrical configuration or battery only operation.

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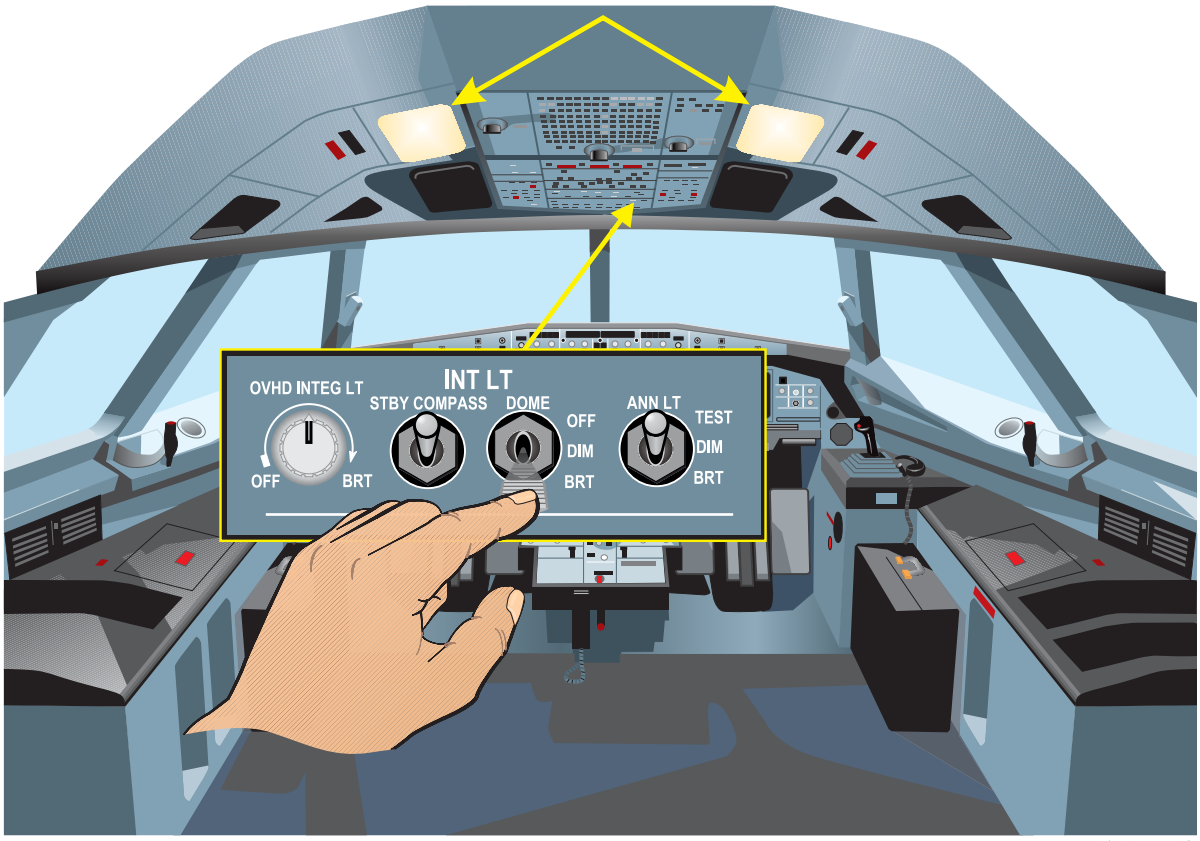

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Flight Deck Lighting (continued)

Specific Area Lighting

The specific area lights include:

- console and floor lights
- reading lights
- pedestal lights

CONSOLE/ FLOOR Lights

There are two incandescent console/floor lights mounted below each pilot's:

- side window facing downward
- sidestick facing aft

These lights illuminate each pilot's side console, briefcase area, and floor area. A switch labeled CONSOLE/FLOOR on each pilot's instrument panel controls these lights.

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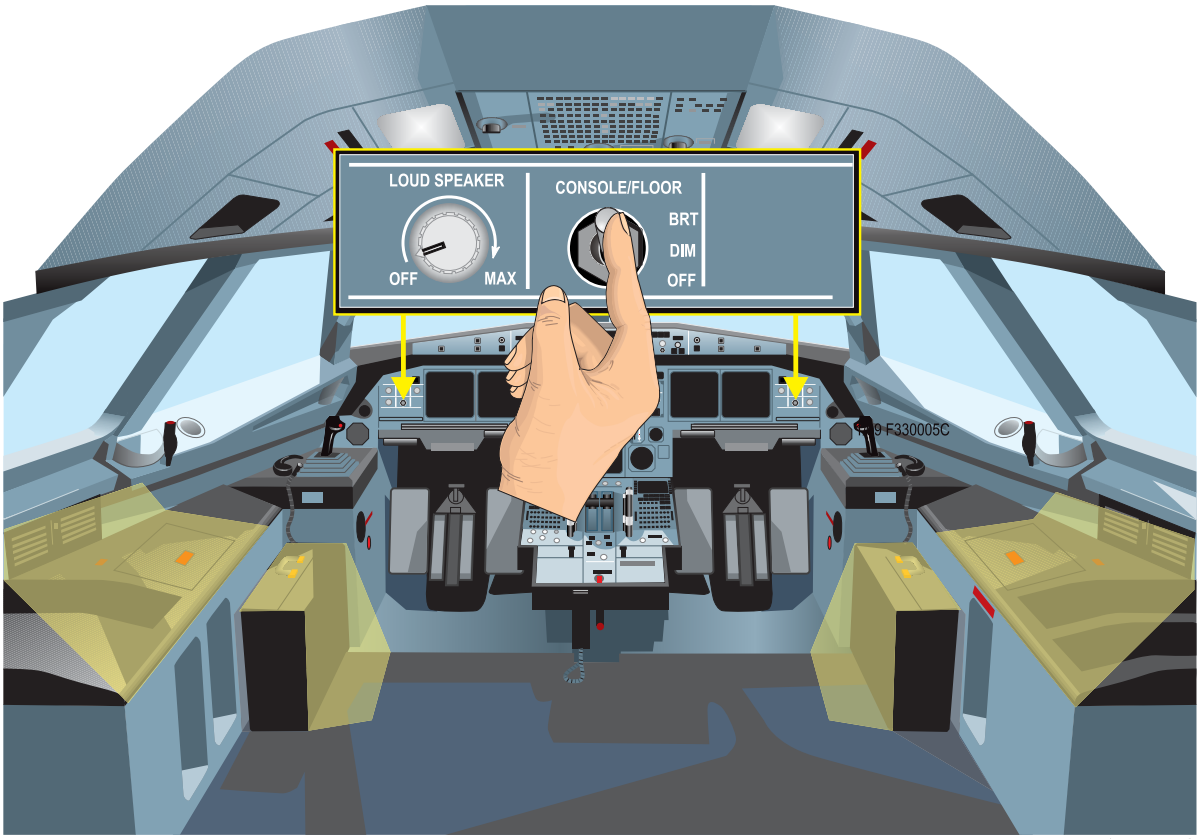

Flight Deck Lighting (continued)

Reading Lights

There are four reading lights. On A320 aircraft 3201-3250 and all A319's, a reading light is installed on a swivel, mounted to the window post of each pilot's sliding window. It is energized automatically when extended from its holder. On A320 aircraft 3251-3270, this light is fixed to the window post and has limited movement. It is energized by an on/off switch mounted adjacent to the light. Both types of lights are rheostat adjustable.

Overhead XCM Light

There are two reading lights in the overhead panel designed to provide illumination for each extra crew member. A rheostat next to the light labeled READING LIGHT controls these lights.

Sliding Table Light (A320 aircraft 3251-3270 and all A319s)

At both pilot stations an additional light is installed under the glareshield directly above the sliding table. Its design provides supplemental lighting for the sliding table

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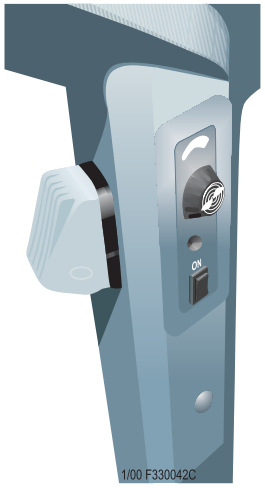
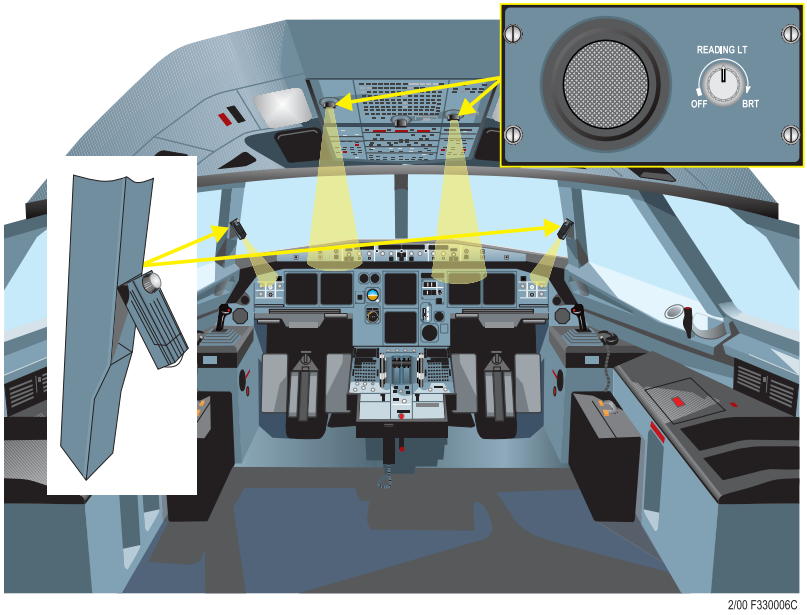


A320 aircraft
3251 - 3270

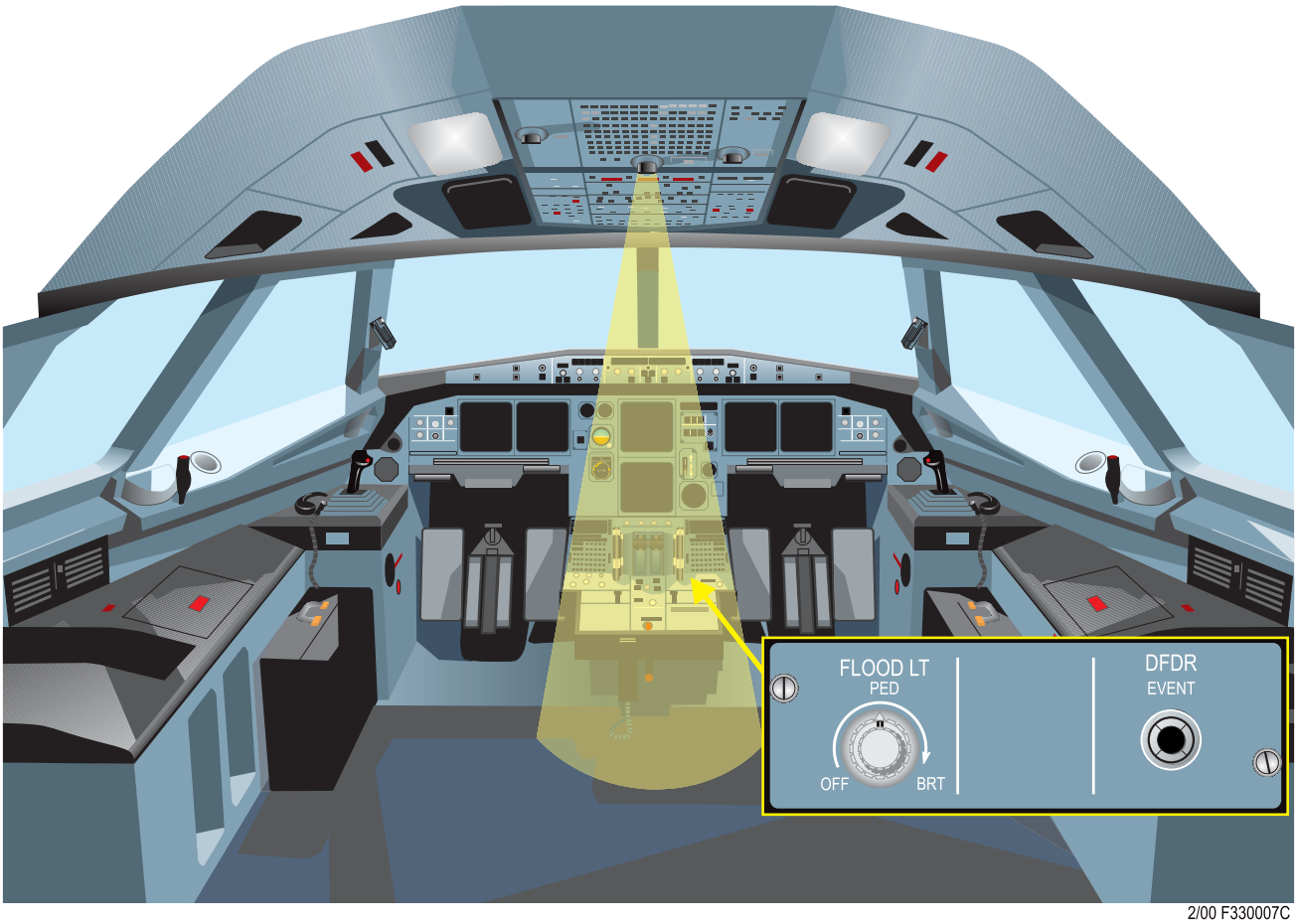


A320 aircraft
3201 - 3250
and all A319s

Flight Deck Lighting (continued)

Pedestal Light

There is one adjustable incandescent light located on the overhead panel to illuminate the aft pedestal. A rheostat on the pedestal, labeled FLOOD LT PED, controls the light.



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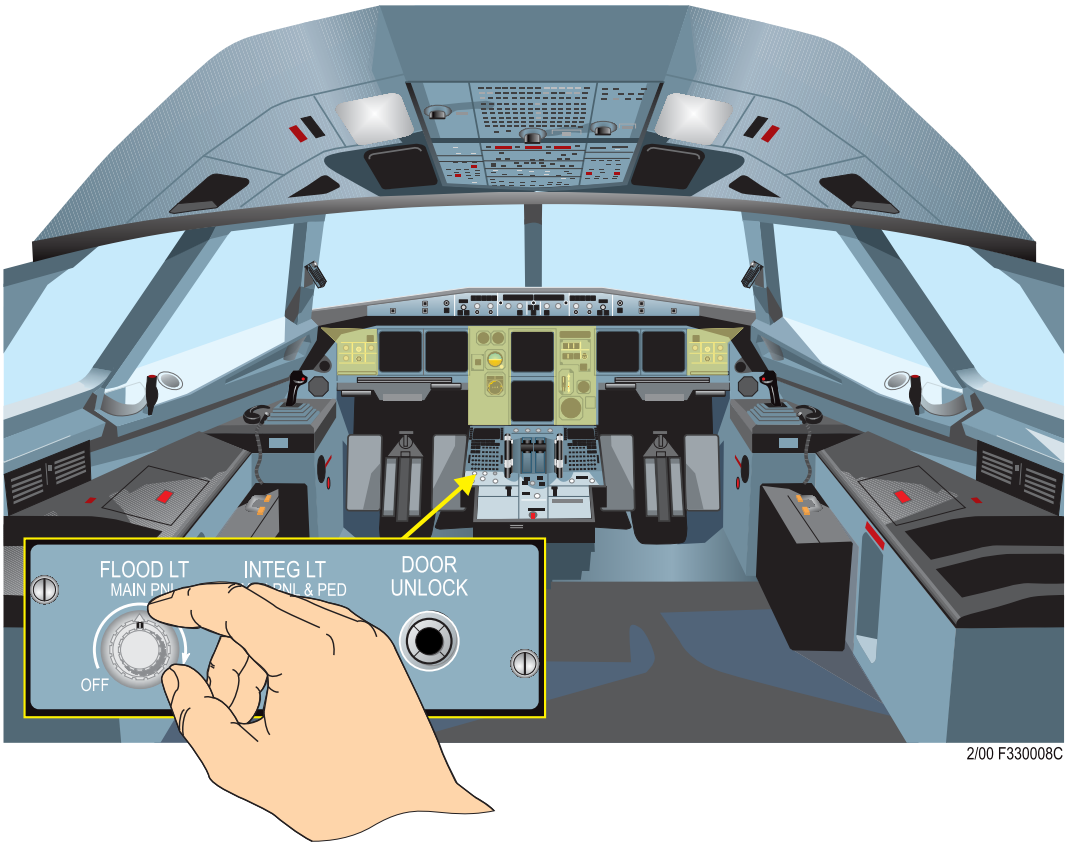
Flight Deck Lighting (continued)

Instrument Flood Lights

There are four flood lights installed under the glareshield for the main instrument panel flood lighting.

A rheostat on the pedestal, labeled FLOOD LT MAIN PNL, controls the flood lights. Only two flood lights on the captain's side operate in the emergency electrical configuration or battery only operation.



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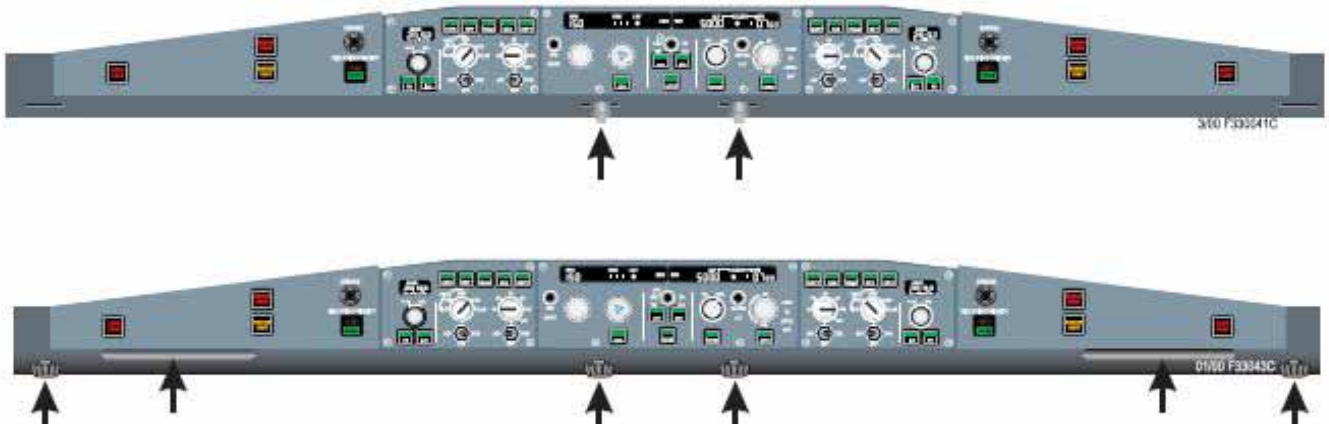
Flight Deck Lighting (continued)

Integral Lights

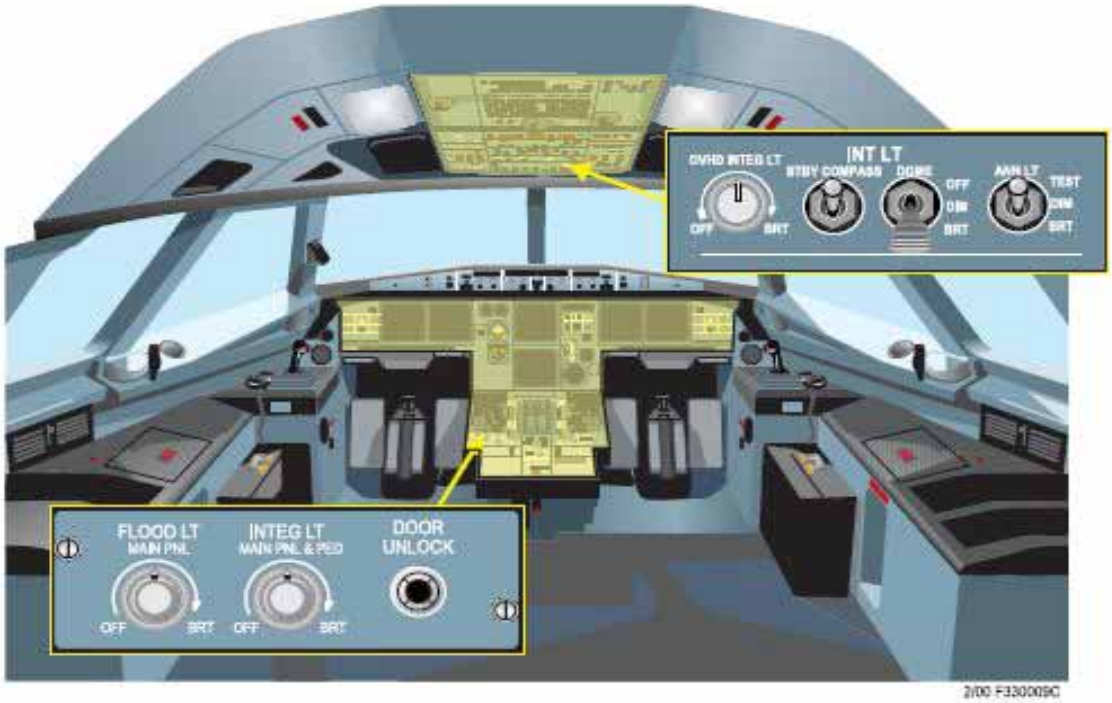
The integral lights are installed:

- in the glareshield FCU
- under the glareshield above the sliding tray tables (A320 aircraft 3251-3270 and all A319s)
- in the overhead panel
- in the main instrument panel
- in the center pedestal



The integral lights are controlled by:

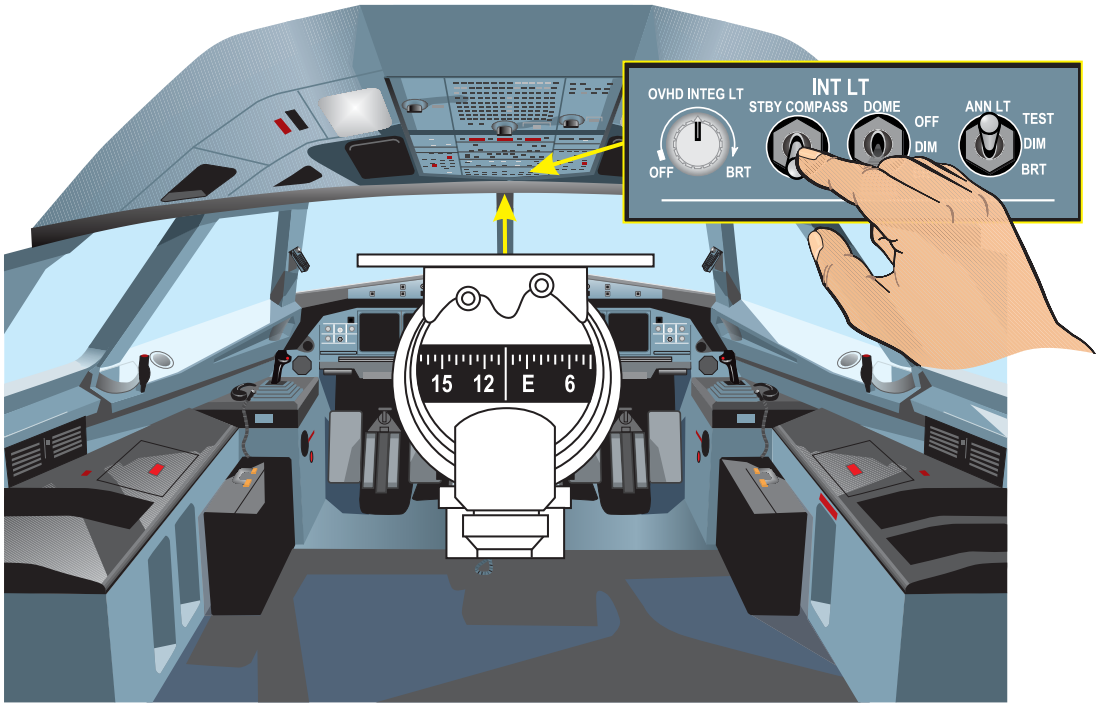
- sliding knobs or rheostats under the FCU
- a rheostat labeled OVHD INTEG LT on the overhead panel
- a rheostat labeled MAIN PNL & PED on the pedestal.



Flight Deck Lighting (continued)

Integral Lights (continued)

The standby compass has an integral light controlled by a switch located on the overhead INT LT panel. The switch is labeled STBY COMPASS. This light operates on battery power only in the emergency electrical configuration.



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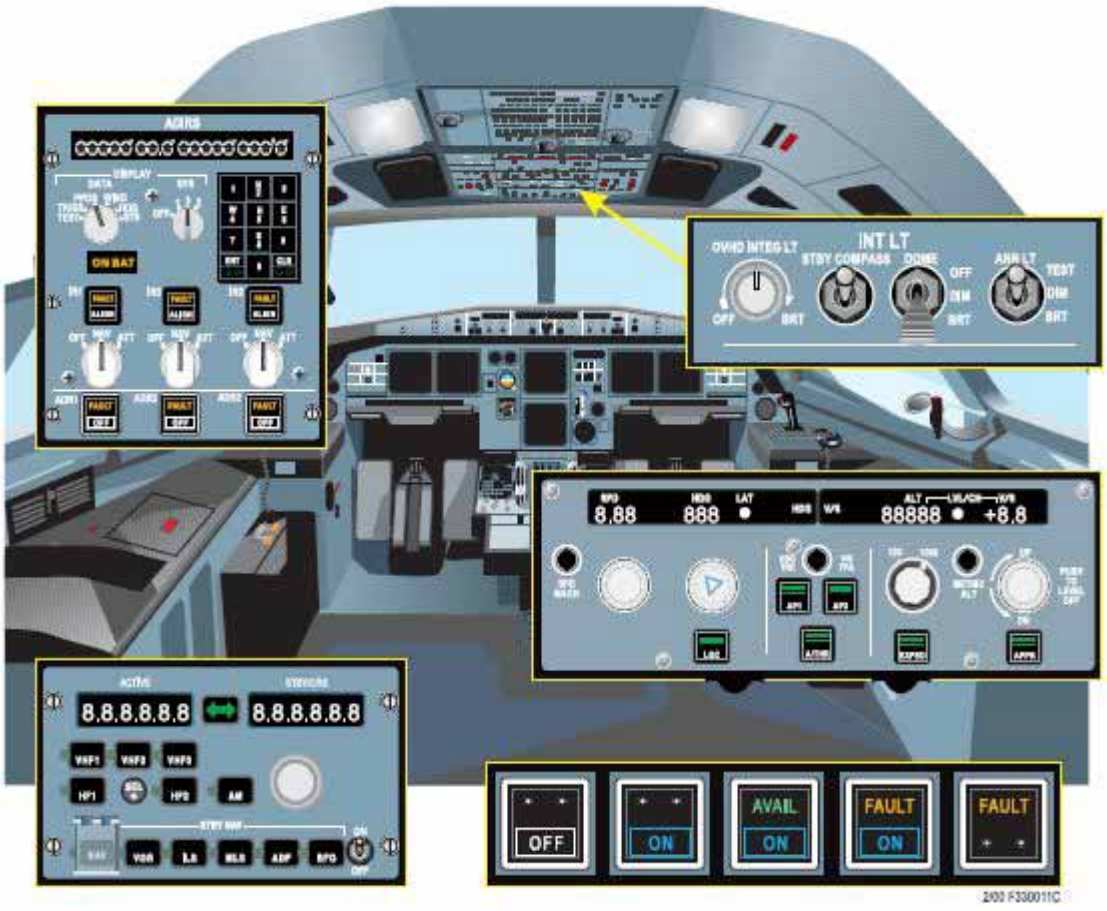
Flight Deck Lighting (continued)

Annunciator Lights

The annunciator lights illuminate to display messages, symbols, or to locate a pb for actuation. They include all pb switches/lights, LDG GEAR lights, and liquid crystal displays (LCDs) in the flight deck.

These lights are controlled by a toggle switch labeled ANN LT which is located on the overhead INT LT panel. It has three positions: TEST, DIM, or BRT. Selecting either DIM or BRT adjusts the brightness. When TEST is selected, the LCD characters appear as 8s. The full appearance of each 8 indicates that each segment is functional. The LCD window on the ADIRS panel uses a snowflake pattern during the test.

Note: Testing the annunciator lights also illuminates all of the failure symbols on the PFD and ND.



Cabin Lighting

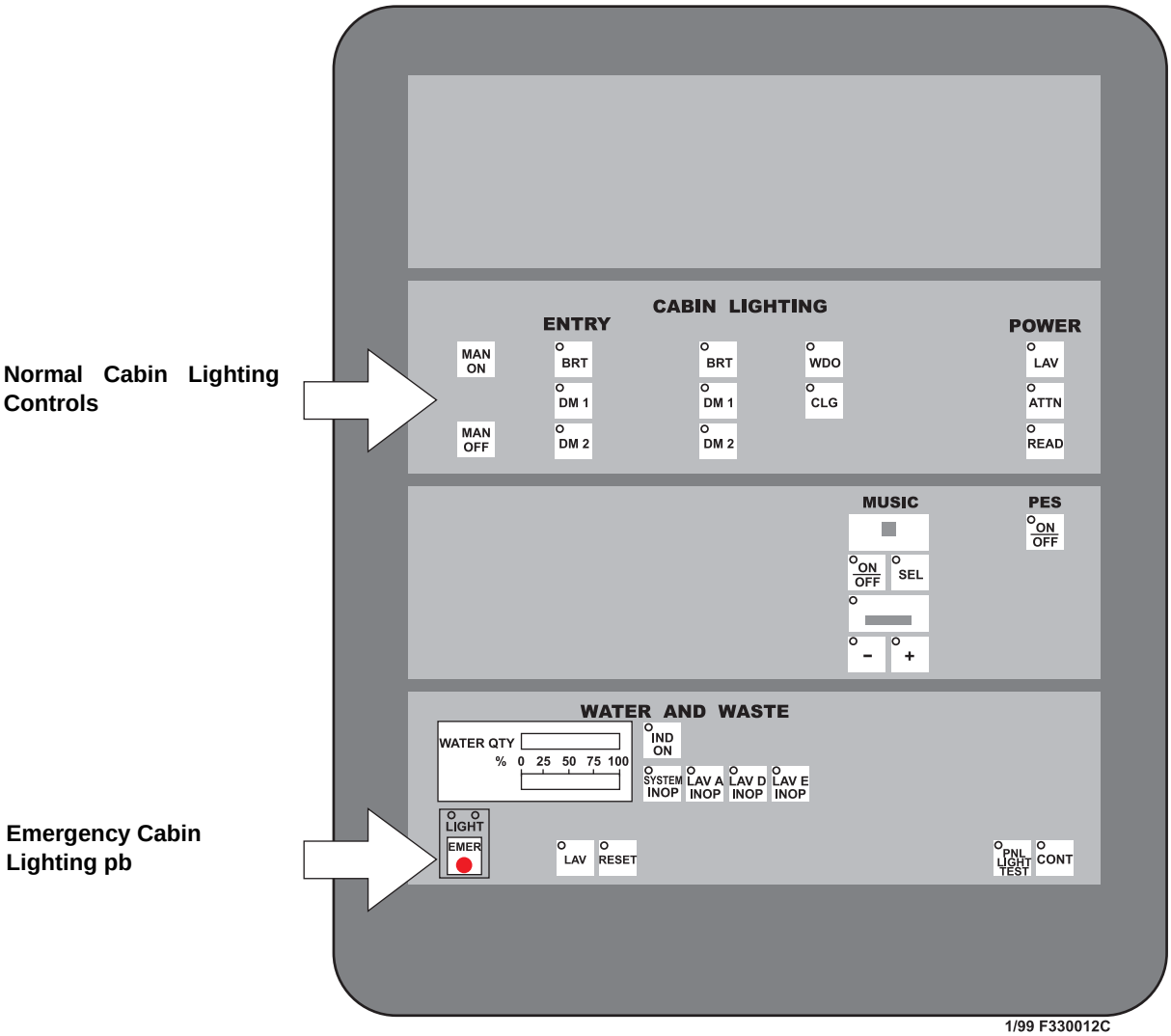
General

Cabin lighting consists of florescent lights, passenger reading lights, and interior emergency lights. The forward flight attendant station controls cabin lighting, except that the reading light control is an on/off pb next to the light at each seat location.

The emergency lights can also be controlled from the flight deck. The emergency lights section covers emergency operation of the cabin lighting.

There are galley working lights installed in and operated from each of the galleys.

Lead FA Station & Cabin Lights



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Exterior Lighting

General

The exterior lights include:

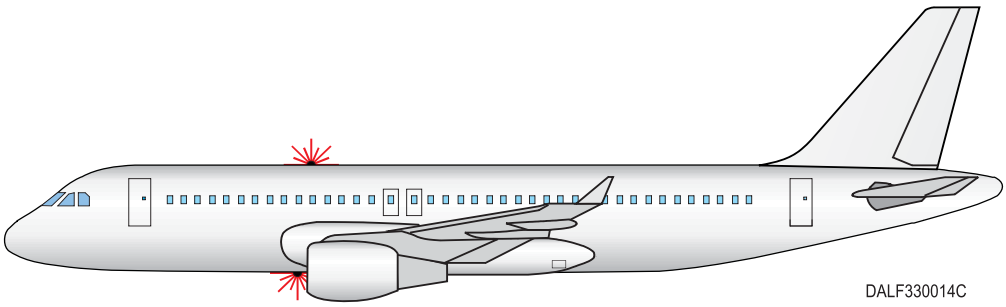
- rotating beacons
- wing lights
- navigation and logo lights
- taxi and takeoff lights
- landing lights
- runway turnoff lights
- strobe lights

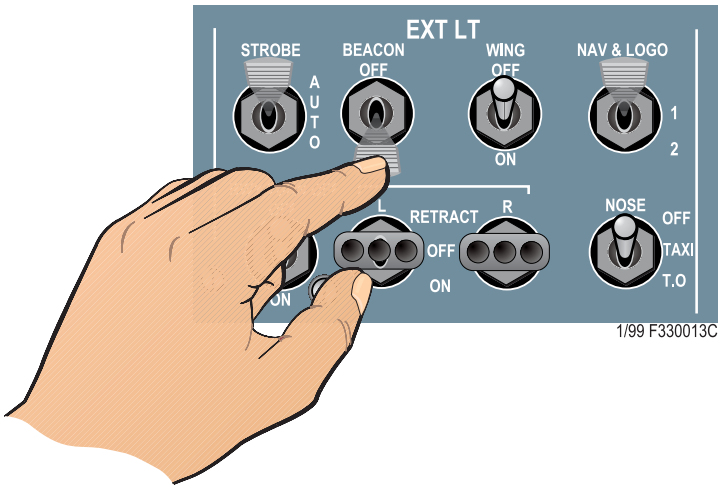
Rotating Beacon

The rotating beacon lights consist of two flashing red lights, one on the top and one on the bottom of the fuselage.

The switch to control these lights is located on the overhead EXT LT panel and is labeled BEACON. The switch has two positions: OFF and ON.

The following illustrates the location of the rotating beacon lights.





Exterior Lighting (continued)

Wing Lights

The wing lights are located on both sides of the fuselage. They illuminate the leading edge of the wings and engine intakes to assist the pilot in visually detecting ice accumulation.

The switch to control these lights is located on the overhead EXT LT panel and is labeled WING. The switch has two positions: OFF and ON.

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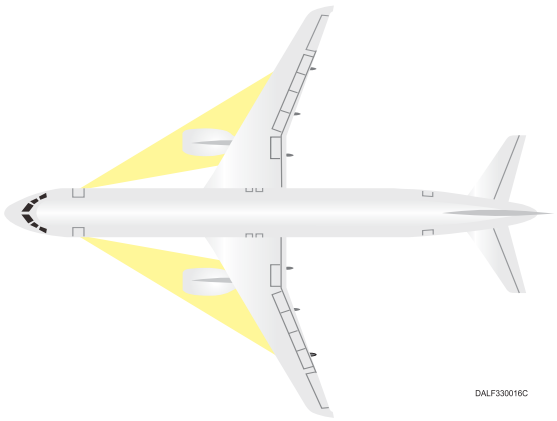
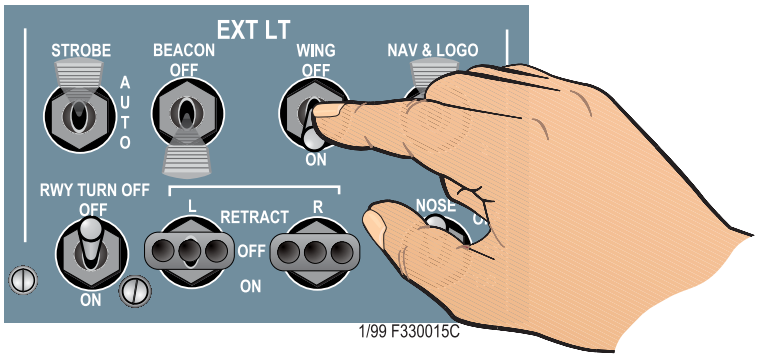




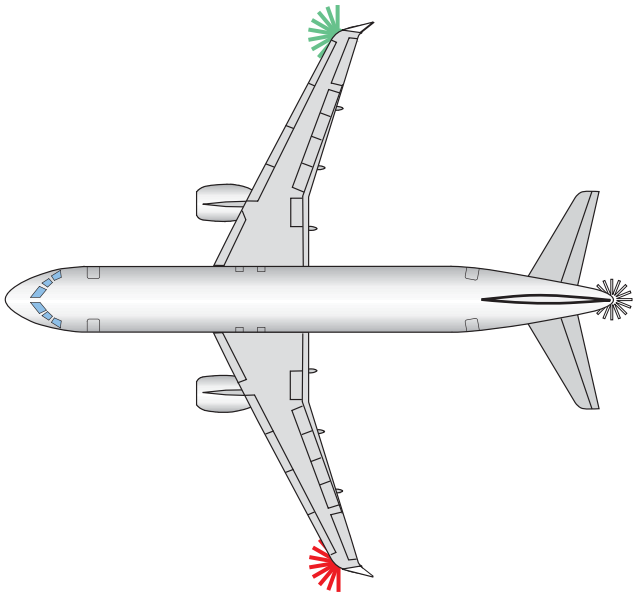
Exterior Lighting (continued)

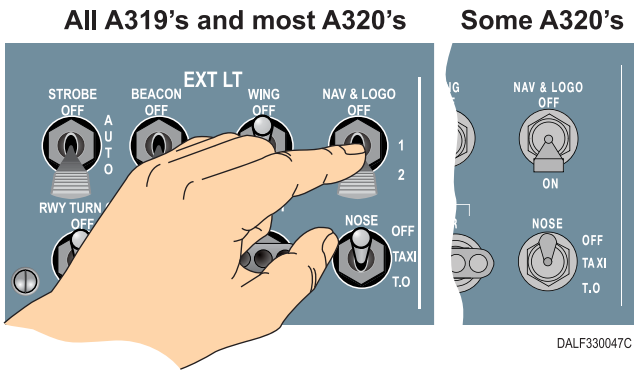
Navigation and Logo Lights

The aircraft's navigation lights are controlled by the NAV & LOGO switch located on the EXT LT overhead panel. Both A319 and A320 aircraft are equipped with the LED bulbs.

The NAV & LOGO switch on some A320s are equipped with an ON and OFF position, while all A319s and most A320s are equipped with an OFF, 1 and 2 positions.

On aircraft equipped with the 1 and 2 positions, selection of either position will activate the single LED bulb.





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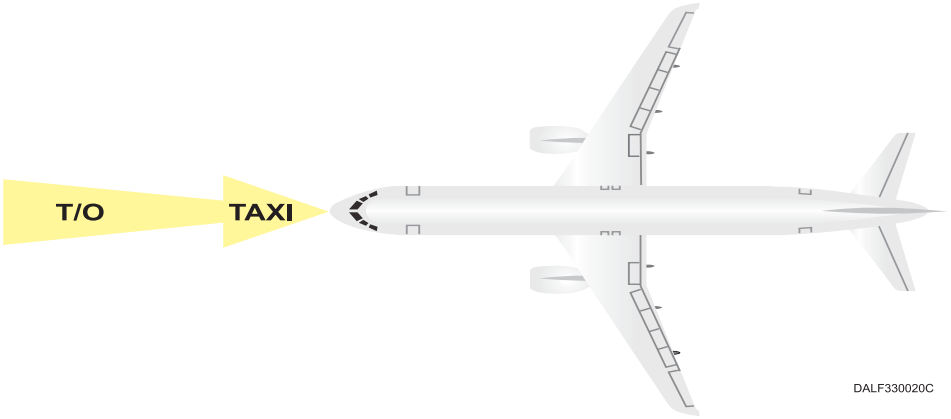
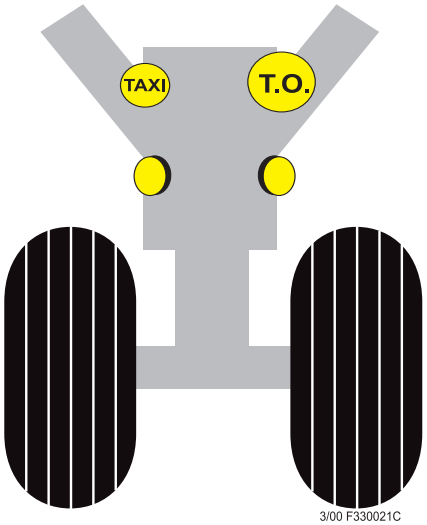
Exterior Lighting (continued)

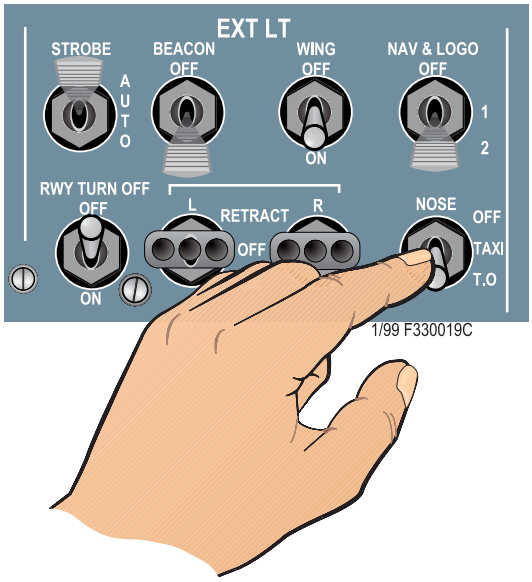
Taxi and Takeoff Lights

The taxi and takeoff lights are mounted on the nose gear strut. The smaller light is the taxi light and the larger light is the takeoff light. A switch labeled NOSE on the EXT LT panel controls these lights. In TAXI, only the taxi light is illuminated, in T.O., they are both illuminated.

These lights automatically extinguish when the landing gear is retracted.







Exterior Lighting (continued)

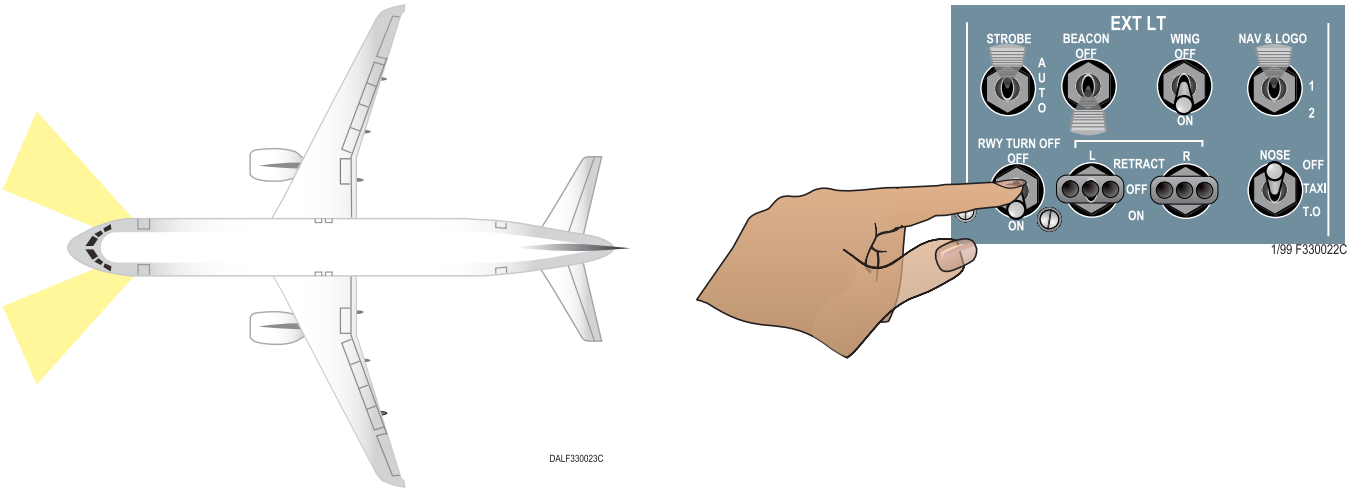
Runway Turnoff Lights

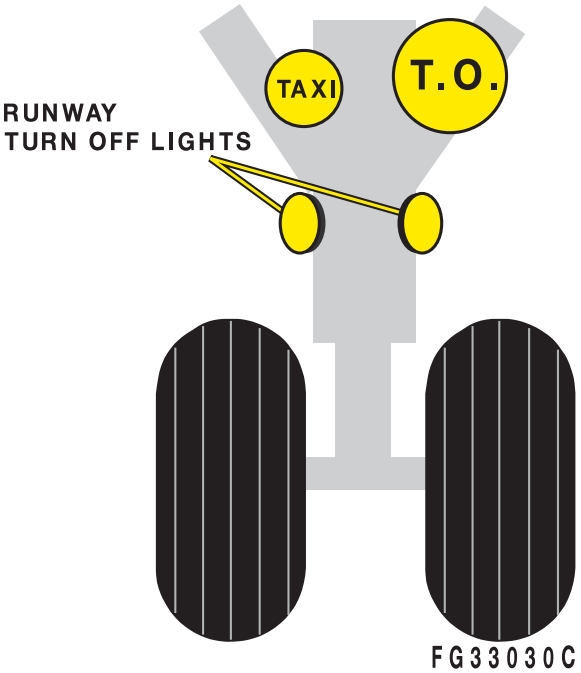
Two runway turnoff lights are installed at a 45° angle on the nose strut and illuminate the areas on both sides of the aircraft.

These lights automatically extinguish when the landing gear is retracted.

A single switch labeled RWY TURN OFF on the EXT LT panel controls these lights.

The switch has two positions: OFF and ON.





Exterior Lighting (continued)

Landing Lights

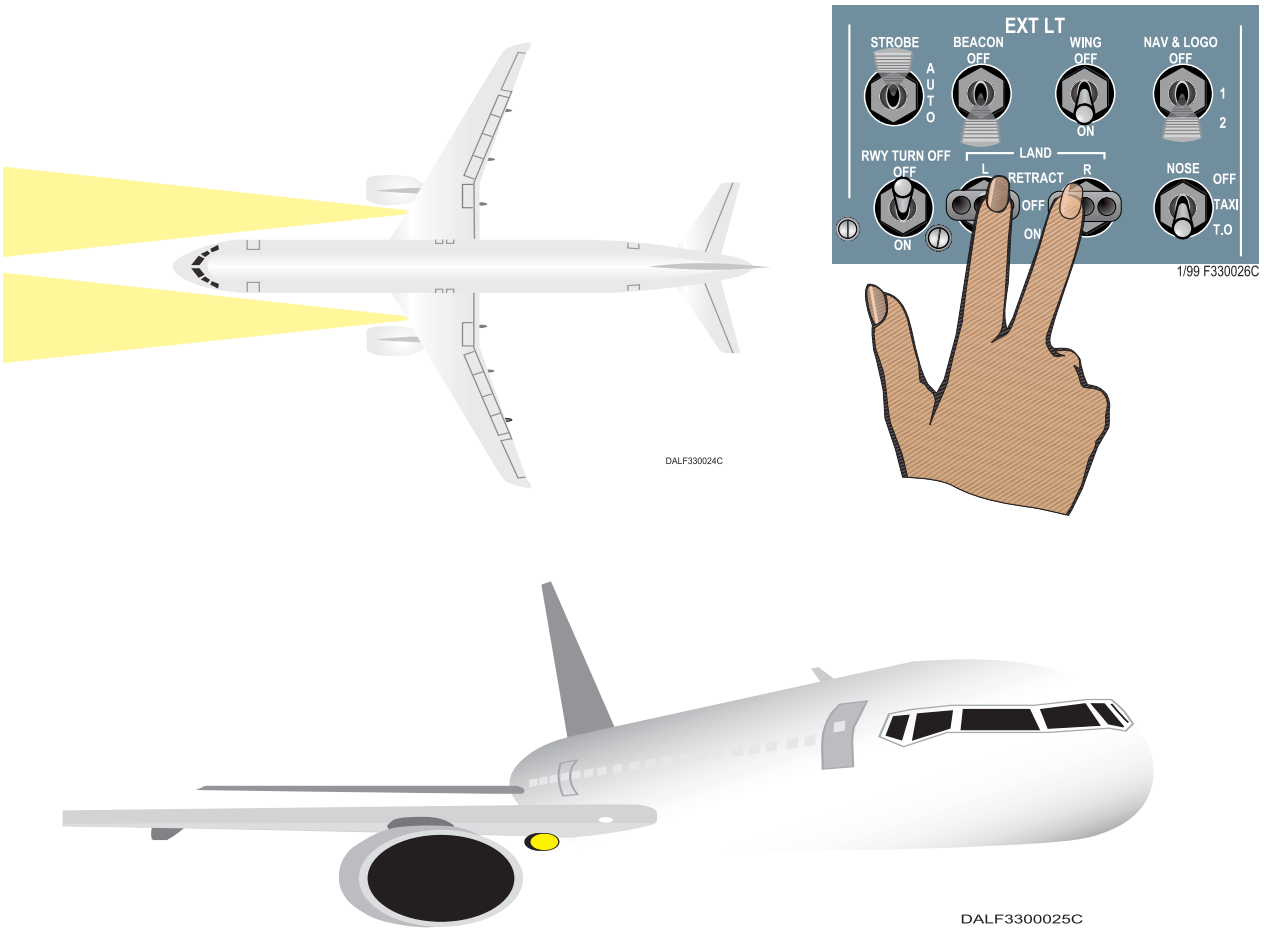
The landing lights are mounted under the inboard portion of each wing and are retractable. The lights will only illuminate when extended.

The lights are controlled by two switches labeled LAND L and R on the EXT LT control panel.

- RETRACT - The lights are off and retracted
- OFF - The lights are off and extended
- ON - The lights are on and extended

There is no speed restriction for the extension and retraction of the landing lights.

Note: Extension of the lights at higher speeds (above approx 280 KIAS) results in airframe buffet.

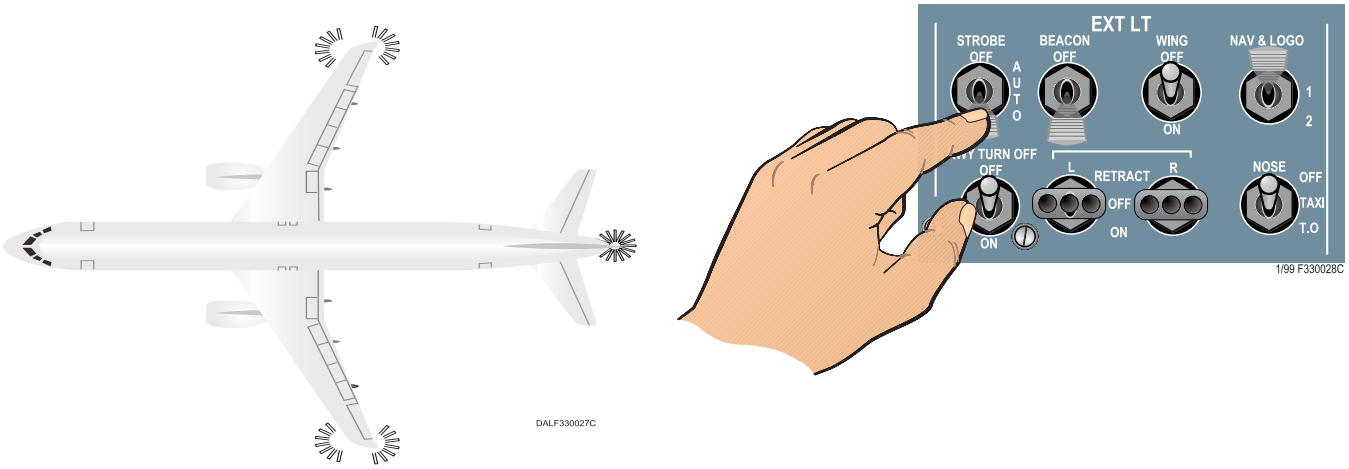


Exterior Lighting (continued)

Strobe Lights

Strobe lights are mounted in each wing tip and the tail cone. A single switch labeled STROBE located on the overhead EXT LT panel controls these lights.

In the ON position the strobe lights operate. In the AUTO position, the strobe lights operate when the landing gear is not compressed (airborne).



Emergency Lighting

General

Emergency lighting consists of:

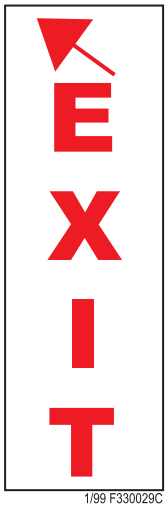
- escape path lighting and signs
- overhead emergency lights
- exit signs
- lavatory auxiliary lights
- escape slide lighting
- flight deck lighting

Escape Path Lighting and Signs

There are escape path lights and EXIT signs to lead passengers to emergency exits in a smoke-filled cabin.

Escape path lights are located on aircraft left, aisle seats. The lens is mounted on the bottom portion of each right hand seat frame. Escape path lights consist of one white light on each coach seat and two red lights designating an exit location. The first class seats each have two white lights.

EXIT signs are located at floor level at each door and window exit. EXIT signs consist of white lighted signs with EXIT printed in red.



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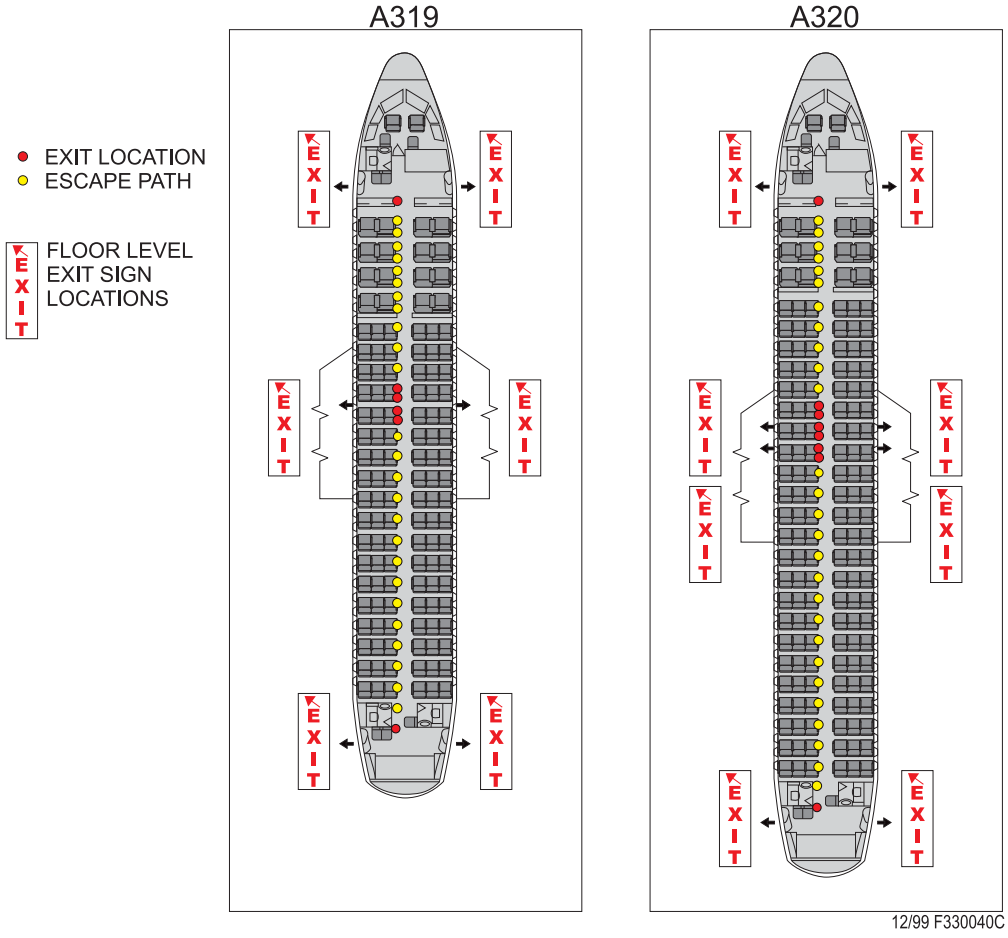
Self contained battery packs lasting up to 12 minutes power the escape path lights and signs. The aircraft electrical system charges these battery packs. These battery packs will not charge when the lights are illuminated.

Emergency Lighting (continued)

Escape Path Lighting and Signs (continued)

When armed, the escape path lights and signs automatically illuminate with loss of the normal aircraft electrical system. They can be manually selected ON with the EMER EXIT LT switch on the overhead SIGNS panel or with the EMER LIGHT pb on the lighting control panel at the lead flight attendant station.

FLOOR LEVEL ESCAPE PATH LIGHTING



Emergency Lighting (continued)

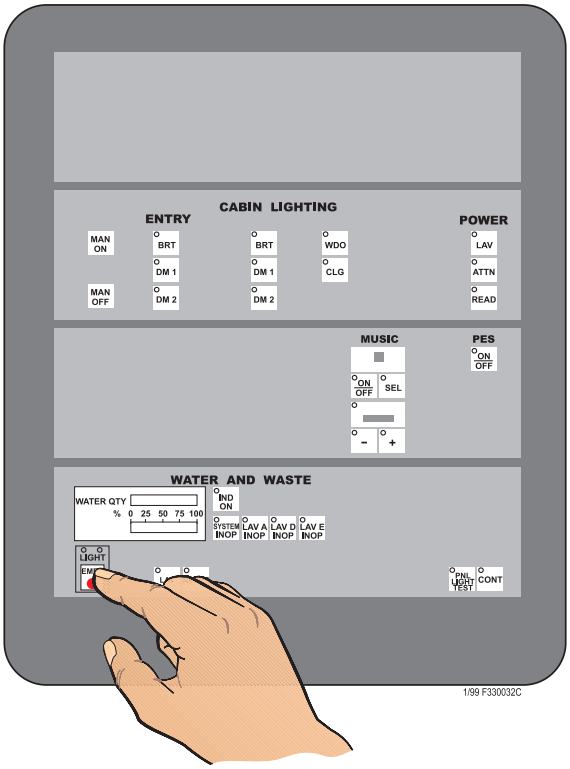
Overhead Emergency Lights

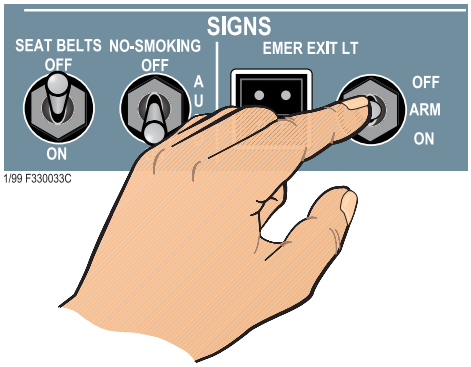
The overhead emergency lights provide general cabin illumination during electrical malfunctions and emergency conditions. These lights include small white lights above the seating area and above each door and window exit.

The aircraft electrical system normally powers these lights. Internal battery packs power the lights in electrical malfunctions and emergency conditions. These battery packs will not charge when the lights are illuminated.

The overhead emergency lights automatically illuminate with loss of the normal aircraft electrical system if the EMER EXIT LT selector is in the ARM position.

They can be manually selected ON with the EMER EXIT LT switch on the overhead SIGNS panel or with the EMER LIGHTS pb on the lighting control panel at the lead flight attendant station.





Emergency Lighting (continued)

Exit Signs

The exit signs point out the location of each exit.

The signs are located:

- above each door exit
- between the window exits (above the window exit of the A319s)
- in the aisle overhead panel, in the vicinity of the exit

The signs are white lighted panels with the word EXIT printed in red

The aircraft electric system normally powers the signs. They can be powered by battery packs that are charged by the aircraft electrical system. These battery packs will not charge when the lights are illuminated.

The exit signs are automatically illuminated:

- when the NO SMOKING sign is selected to the ON position
- when the NO SMOKING sign is selected to the AUTO position and the landing gear is extended
- when cabin emergency lights are on
- at excessively high cabin altitudes

They can be manually selected ON with the EMER EXIT LT switch on the overhead SIGNS panel or with the EMER LIGHTS pb on the lighting control panel at the lead flight attendant station.

Emergency Lighting (continued)

Lavatory Auxiliary Lights

Lavatory auxiliary lights are located in the lavatory overhead to provide light before the door is locked.

The aircraft electrical system powers these lights. The lavatory auxiliary lights always illuminate when electrical power is supplied.

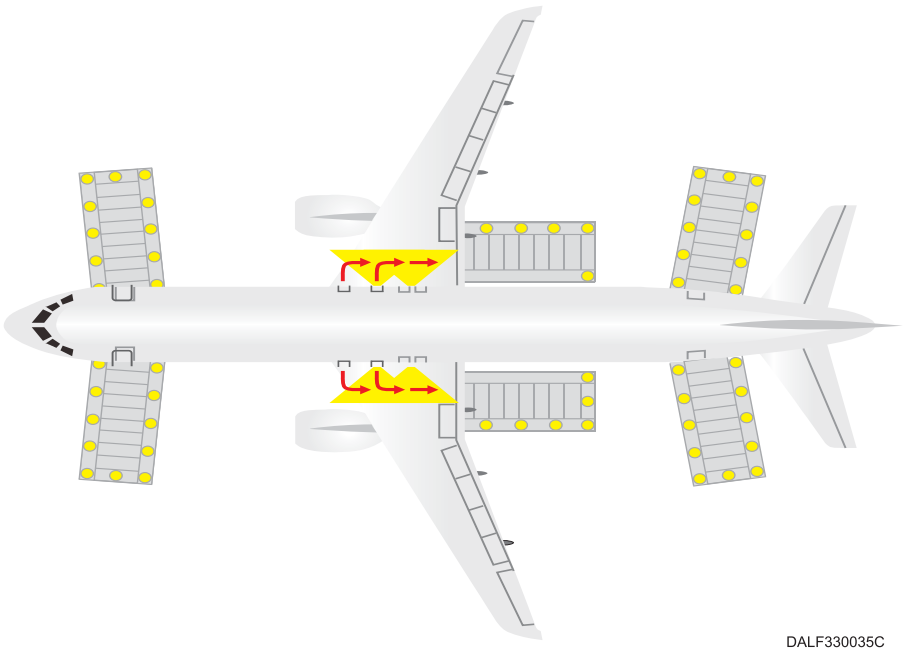
Escape Slide Lighting

The escape slide lighting provides illumination during evacuation of the aircraft.

Escape slide lighting consists of lights on the overwing slides, door slides and overwing escape route lights located below the window emergency exits.

Internal battery packs charged by the aircraft electrical system, power escape slide lighting.

The lights automatically illuminate when a slide is deployed.



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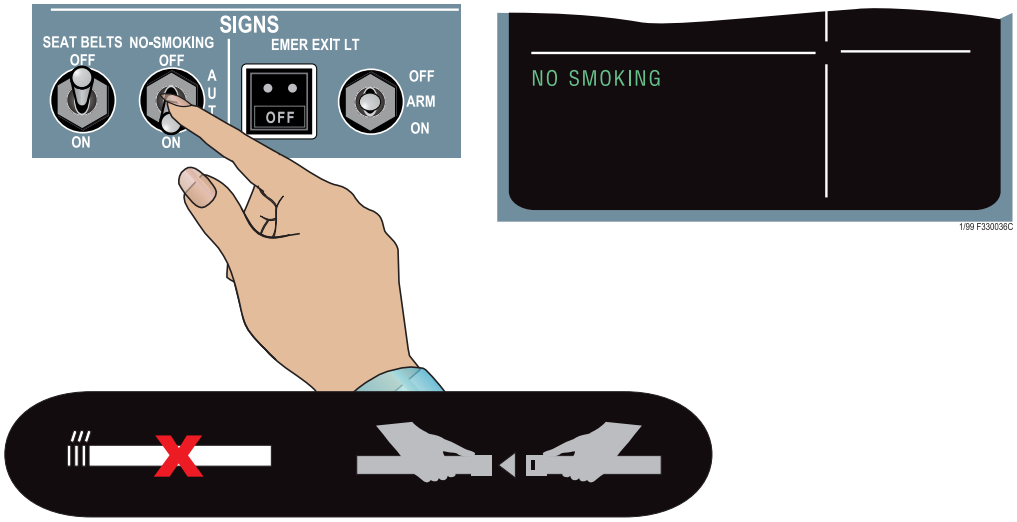
Cabin Signs

General

The cabin signs consist of the NO SMOKING sign and the FASTEN SEAT BELT sign. Each lavatory has a RETURN TO YOUR SEAT sign.

NO SMOKING Sign

A three position switch on the overhead panel SIGNS panel illuminates the NO SMOKING signs. The switch controls the illumination of NO SMOKING signs throughout the cabin. With the switch in either the ON or AUTO position, the NO SMOKING signs are illuminated when electrical power is established on the aircraft.



The ECAM message NO SMOKING appears on the E/WD memo section when:

- the NO SMOKING switch is placed in AUTO and the landing gear is extended
- the NO SMOKING switch is ON.

A permanent NO SMOKING sign is installed in the lavatories and galleys.

A low-tone chime sounds when the illumination is changed either manually or automatically.

The NO SMOKING and EXIT signs illuminate at excessively high cabin altitudes, regardless of switch position.

DAL procedure is to have the NO SMOKING switch in the AUTO position at all times except when the aircraft is being secured.

Note: It may appear that the AUTO and ON function of the NO SMOKING switch are the same. However in the AUTO position, the EXIT signs extinguish when the gear is up allowing the battery packs for the cabin emergency lighting to charge.

Cabin Signs (continued)

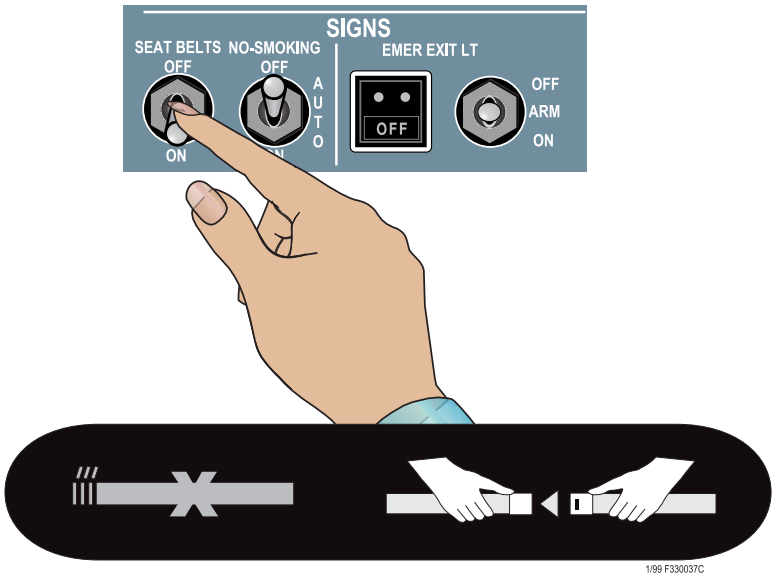
FASTEN SEAT BELT Sign

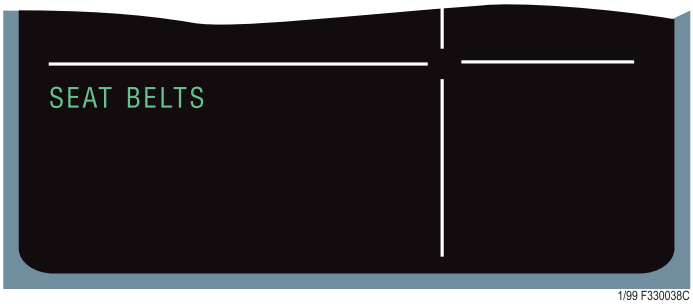
A switch on the overhead SIGNS panel controls the FASTEN SEAT BELT signs throughout the cabin and RETURN TO YOUR SEAT sign in each lavatory.

The two position switch is labeled SEAT BELTS and is either OFF or ON. A SEAT BELTS ECAM message also appears on the E/WD memo section

A low-tone chime sounds when the illumination is changed either manually or automatically.

The FASTEN SEAT BELT sign automatically illuminates with excess cabin altitude.

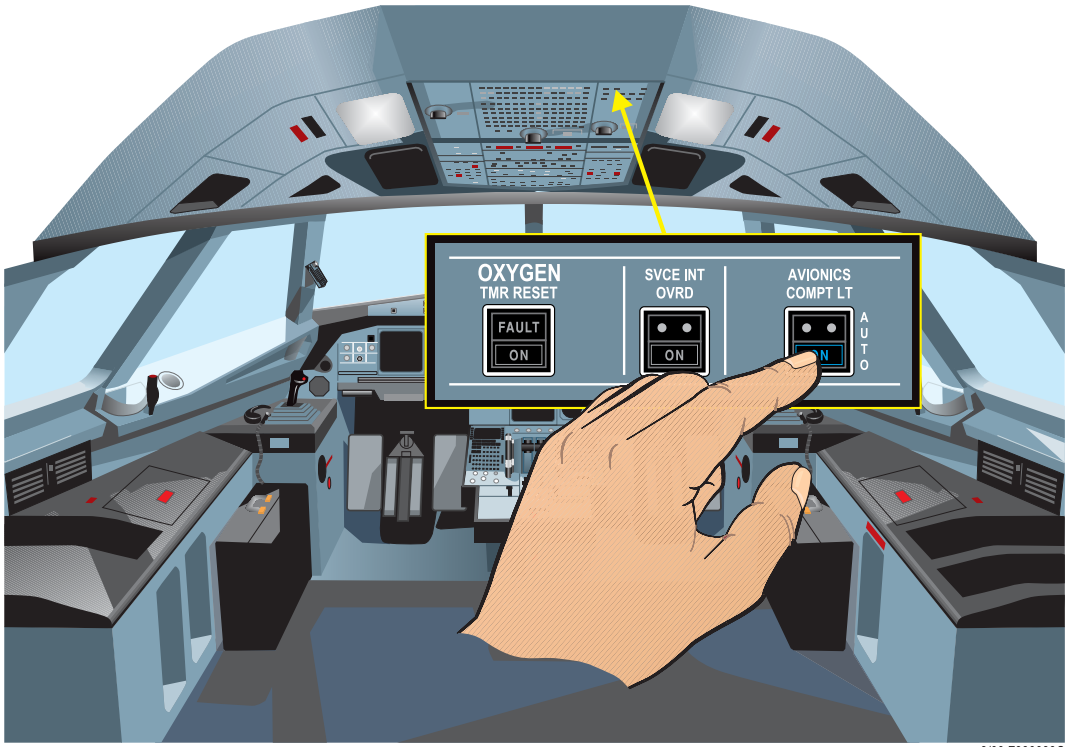




AVIONICS COMPT LT

Function

An incandescent light illuminates the avionics compartment. It is controlled by a pb labeled AVIONICS COMPT LT located on the overhead maintenance panel.



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AUTO

The avionics door opening automatically controls the avionics compartment lighting.

ON

The avionics compartment light is on.

Chapter 34: Navigation

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General Description

Overview

Effective and efficient operation of the A319/320 aircraft requires an understanding of the autoflight, flight instruments, and navigation systems and the interrelationship between them.

This Navigation chapter covers the following subject areas in separate sections:

- Radio Navigation Systems and ADIRS - Radio navigation, Radio Altimeters, transponders, ADIRS, and GPS
- Weather radar
- Flight Management and Guidance Computers (FMGCs)
- Performance optimization - Lateral and vertical path functions
- Multifunction Control and Display Units (MCDUs) - General arrangement and operation
- MCDU Operations - An introduction to operating the FMS
- MCDU Navigation Page reference

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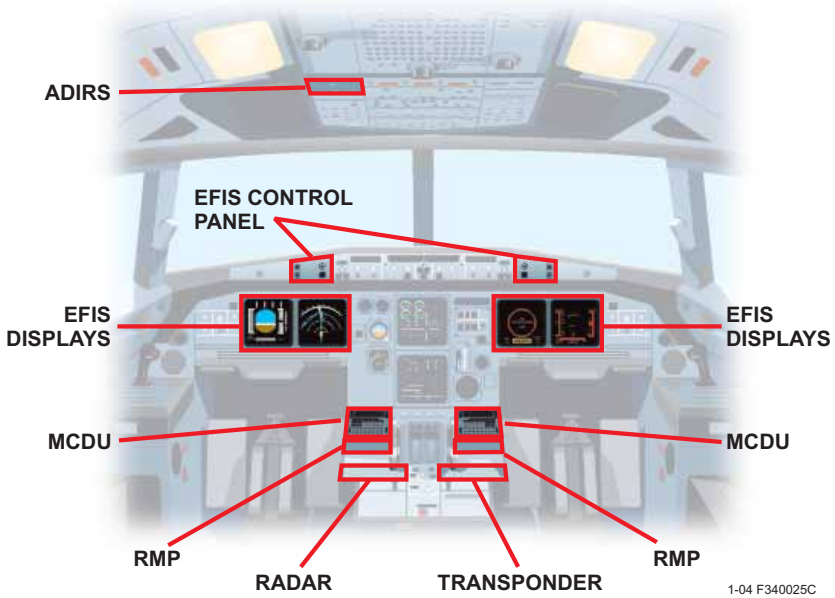
Radio Navigation and ADIRS

Location of Components

Systems associated with the navigation and the Air Data Inertial Reference System (ADIRS) include the:

- Navigation radio receivers (VORs, DMEs, ILSs, ADF. and Marker Beacons)
- Radio Management Panels (RMPs)
- Radio altimeters (RA)
- Transponder
- Air Data and Inertial Reference System (ADIRS)
- Global Positioning System (GPS)
- Multifunction Control and Display Units (MCDUs)
- Flight Management and Guidance Computers (FMGCs)
- Electronic Flight Instrument System (EFIS)

Components are located throughout the cockpit as depicted below.



Navigation System

General Description

The GPS, ADIRS, FMGC, and other systems are integrated into the Flight Management System (FMS). The FMS is designed to minimize pilot workload by automatically computing aircraft position, tuning enroute navaids, and optimizing performance. The two FMGCs independently compute and compare aircraft position. Either FMGC is capable of performing all operations if the other FMGC fails.

The FMS optimizes aircraft performance both laterally and vertically. Climb speeds, cruise speeds, cruise altitudes, and descent profiles are optimized to minimize cost and fuel. Predictions for en route times and fuel, step climbs, step descents, and the optimum descent profile are presented for crew use and modification.

Navigation System (continued)

General Description (cont.)

All aircraft are equipped with GPS will have one of the following GPS system architectures:

- **Hybrid system:** The three IRSs use GPS to calculate a hybrid GPIRS position which is sent to FMGC 1 and 2. The IRS positions are corrected by the FMGC through a filter, using GPS position, to determine the mixed best FMGC position.
- **Autonomous system:** IRS positions and GPS positions are sent to FMGCs. IRS positions are corrected by a filter to determine the mixed best FMGC position. Each FMGC uses its associated GPS and calculates independently. Thus, there may be a slight difference between the two FMGC positions.
- **GPS not available (deselected or lack of coverage):** The FMGCs use IRS and radio position. The IRS positions are corrected through a filter to determine the mixed best FMGC position.

The type of GPS architecture may be determined from the POSITION MONITOR page of the FMS. (Hybrid being represented by GPIRS and Autonomous by GPS). From a procedural standpoint there is no difference to the flight crew in the operation of the two architectures.

The ADIRS provides inertial position data to the FMGC. The FMGC automatically tunes radio navigation stations as required for display, for use in a selected procedure, or for IRS position refinement. Navigation is normally accomplished by the FMGC following the flight plan course entered by the crew. The navigation system cannot be coupled to VOR or ADF raw data.

Pilot Interaction

The pilots interact with the navigation and flight management systems through the:

- Multifunction Control and Display Units (MCDUs)
- Flight Control Unit (FCU)
- Radar and transponder control panels
- Radio Management Panels (RMPs)
- ADIRS control panel

Navigation System (continued)

System Monitoring

The status and performance of the navigation systems can be monitored on the:

- Flight Mode Annunciators (FMAs)
- Primary Flight Displays (PFDs)
- Navigation Displays (NDs)
- Digital Distance and Radio Magnetic Indicator (DDRMI)
- MCDUs.

Navigation System (continued)

Flight Overview

During preflight, the pilot enters the flight plan into the FMS via the MCDU, and the Inertial Reference System (IRS) is aligned. Operation of the navigation system requires minimal pilot workload for the remainder of the flight. Departure procedures, en route airways, arrival procedures, and approach procedures are selected by the pilot from the FMS data base and displayed on the ND.

The FMS constantly computes and displays the aircraft position using GPS and IRS data and automatically tunes and identifies en route navaids. The pilot can monitor automatically tuned navaids on the ND. If desired, the pilot can manually tune navigation radios for display purposes without affecting FMS navigation.

When preparing for the final approach, the desired approach procedure is selected via the MCDU. The waypoints and altitudes for the approach and missed approach procedure are stored in the database, and are entered into the flight plan when the approach is selected. The FMS automatically tunes and identifies ILS, VOR, and NDB approach navaids, which the pilot displays on the PFD and/or ND.

The pilot can display the approach flight plan on the ND. Waypoints on the approach are automatically sequenced erased when overflown. The missed approach waypoints are also displayed and allow the pilot to select automatic guidance (e.g., “managed” guidance) along the missed approach flight plan following a go-around.

An alternate airport can also be entered in the flight plan, along with a desired routing to the alternate.

After landing, the previous flight plan is automatically erased in preparation for the next leg.

VOR, ADF, and DME Receivers

General

Two VOR, two DME, and one ADF receivers are installed. The data from each may be displayed on the ND and the DME/VOR information is always displayed on the DDRMI.

The VOR/DMEs are normally autotuned by the FMS. The pilot can manually tune a VOR/DME for display via the MCDU. VOR/DME information can be displayed in all ND modes except PLAN.

In the event of dual FMGC failure, the VOR/DMEs can be tuned using STBY NAV tuning on the RMPs (refer to Navaid Tuning, discussed later). In this case, VOR information is displayed normally on the DDRMI and can also be displayed on the ND in the ROSE ILS and ROSE VOR modes.

VOR Receivers

Two VOR receivers are installed. VOR information can be displayed on the ND and the DDRMI.

The VORs are normally autotuned by the FMS. The VORs can also be manually tuned on the MCDU RAD NAV page or by using STBY NAV tuning on the RMPs. (e.g. in the event of a dual FMGC failure).

VOR/DME information can be displayed on the ND in all modes except plan.

DME Receivers

Two DME receivers are installed. Five channels in each DME receiver allow multiple stations to be tuned by the FMGC at the same time. Three channels are used for FMS radio position updating, one channel for VOR-DME display and one for ILS-DME display.

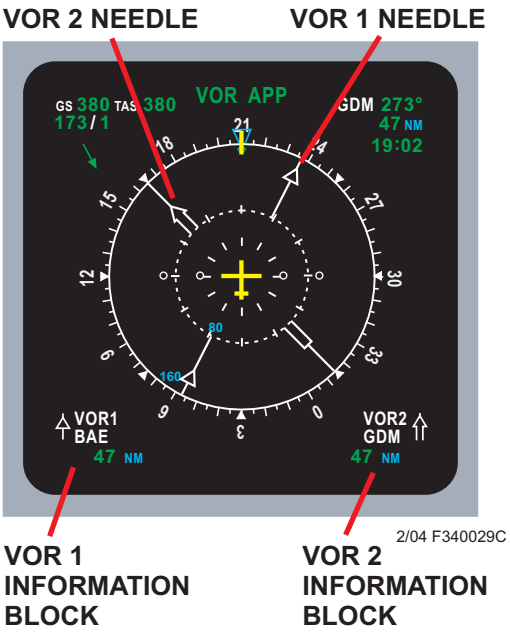
VOR/DME/ADF ND Displays

Both VOR needles may be displayed on either ND in all modes except PLAN.

The EFIS VOR/ADF selectors must be selected to VOR to display VOR/DME information or to ADF to display ADF information.

The needles for the selected radio do not appear until the tuned signal is being received. ND VOR displays are discussed in detail in chapter 31, Flight Instruments.

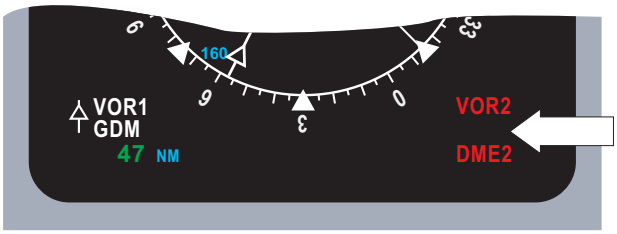
DME is displayed on the ND when available. ILS DME is displayed on the PFD when the ILS pb has been select on the EFIS control panel.



VOR, ADF, and DME Receivers (continued)

VOR/DME ND Displays (continued)

A red VOR or DME warning indicates that a failure has occurred in the associated receiver. These flags appear only when the associated EFIS VOR/ADF selector is selected to VOR.



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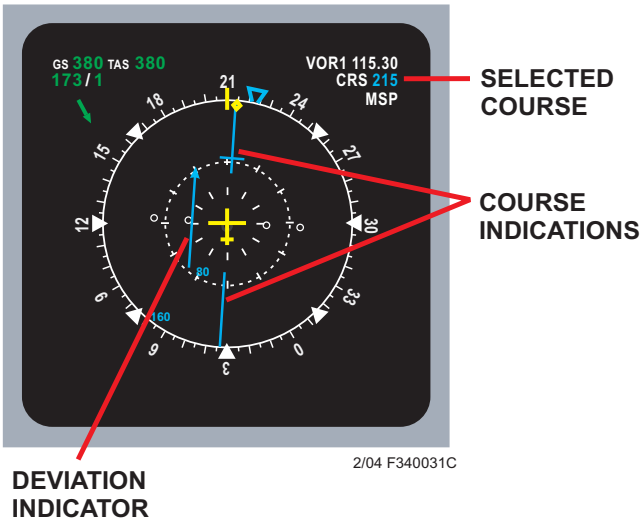
Note: If a ground based VOR failure occurs, the respective needle will no longer be displayed on the ND. Additionally, the VOR information block will change from the three letter identifier to the numeric frequency (i.e. MSP will change to 115.3)

Course Deviation Indicator

A VOR Course Deviation Indicator (CDI) may be displayed in the ROSE VOR mode, as follows:

- A course selected for VOR 1 is displayed on the captain's ND.
- A course selected for VOR 2 is displayed on the first officer's ND.

The CDI course is not displayed on the ND until a course has been manually selected for the associated VOR. The deviation indicator is displayed when the tuned VOR signal is received. The captain's ND is shown in the ROSE VOR mode.



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The ROSE VOR mode is discussed in detail in chapter 31, Flight Instruments.

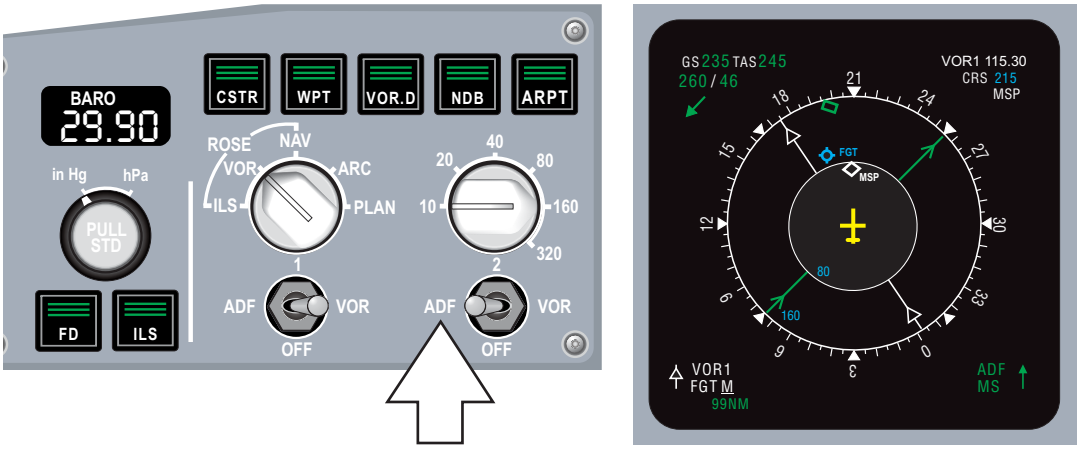
VOR, ADF, and DME Receivers (continued)

ADF Receivers

One ADF receiver is installed. ADF information is displayed only on the ND.

ADF Display

The green ADF needle is displayed on the ND by moving either EFIS VOR/ADF selector switch to ADF. ADF information is displayed in all ND modes except PLAN. The ADF needle does not appear until an ADF station has been tuned and the signal is received.



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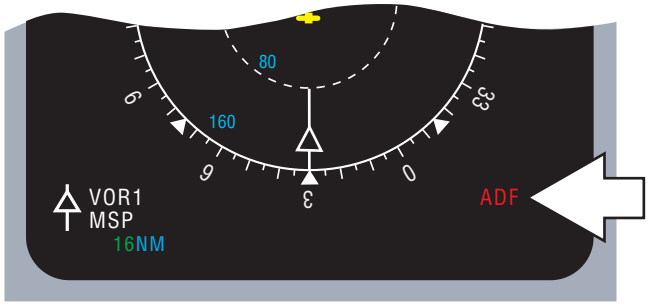
In the event of dual FMGC failure, the ADF receiver can be tuned using STBY NAV tuning on the RMPs (refer to Navaid Tuning, discussed later). In this case, ADF information is displayed on the ND only in the ROSE ILS and ROSE VOR modes.

A red ADF warning flag indicates that a failure has occurred in the receiver. The flag appears only when the receiver has failed and the associated EFIS VOR/ADF selector is selected to ADF.



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VOR, ADF, and DME Receivers (continued)

VOR/DME DDRMI Displays

Both VOR needles are always displayed on the DRMI, along with the associated DME.

A red VOR flag is displayed if:

- The VOR receiver is inoperative or
- A VOR signal is not received or in range.

A red heading flag is displayed if:

- The DDRMI is inoperative or
- The DDRMI is not displaying a reliable compass heading. (Note: Normal heading source IR1, backup source IR3. Loss of both IR 1+3 DDRMI heading unrecoverable.

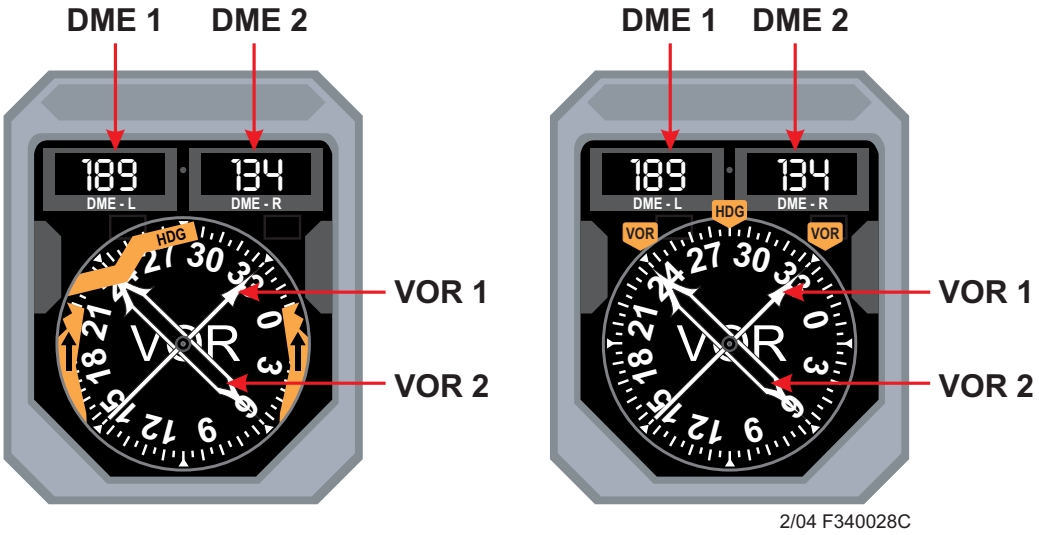
Note: Both VOR flags will appear if HDG flag is displayed.

One of two types of DDRMI can be installed: either a Collins or a Bendix.

VOR, ADF, and DME Receivers (continued)

VOR/DME DDRMI Displays (continued)

DDRMI displays are discussed in detail in chapter 31, Flight Instruments. The two types of DDRMI are shown below.



Collins **Bendix**

A heading (HDG) flag indicates that the heading source for the DDRMI is unreliable. Both VOR flags are displayed when the HDG flag is displayed.

Loss of Signal

If a VOR signal is not received:

On the Collins DDRMI:

- The VOR needle freezes at the current heading
- The VOR flag is displayed.

Note: The display of a VOR flag on Collins DDRMI does not necessarily indicate a VOR receiver failure.

On the Bendix DDRMI:

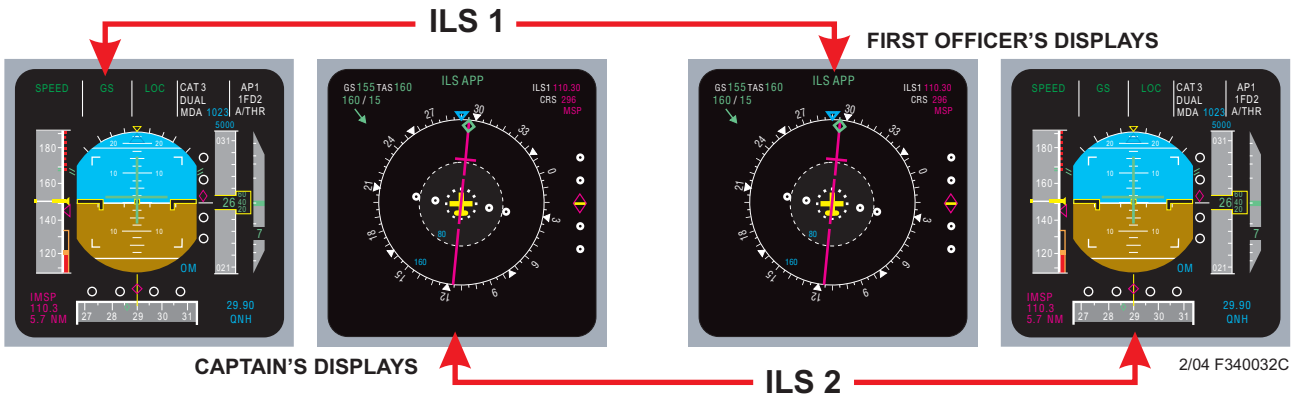
- The VOR needle automatically slews to a 90° right relative bearing (3 o'clock).
- The VOR flag is displayed.

ILS Receivers

Description

Two ILS receivers are installed. ILS information can be displayed on the PFD and ND. To allow both pilots to display ILS information in the event of a single receiver failure, the information on the ND is provided by the opposite ILS receiver, as shown below:

Each ILS reciever is contained within one of two integrated Multi Mode receivers (MMR). Each MMR also includes a GPS receiver.



The ILS receivers are normally autotuned by the FMS. The pilot can manually tune an ILS via the MCDU. A DME associated with an ILS is automatically tuned when the ILS is tuned.

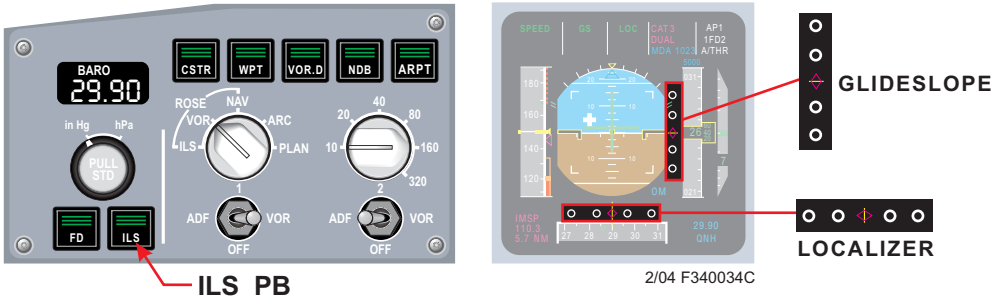
In the event of dual FMGC failure, the ILS can be tuned using STBY NAV tuning on the RMPs (navaid tuning is discussed later).

Note: Both ILS receivers are always tuned to the same frequency.

ILS Receivers (continued)

ILS PFD Display

ILS information is displayed on the PFD only when the EFIS ILS pb is illuminated.



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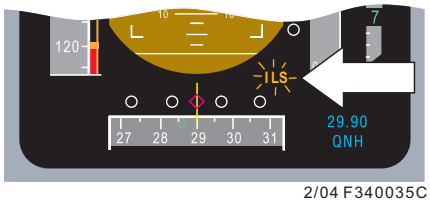
To remind the pilot to display the ILS scales on the PFD during an ILS approach, a flashing amber ILS is displayed on the PFD if:



2/04 F340035C

- An ILS approach has been entered into the flight plan (refer to MCDU Operations)
- The FCU approach (APPR) pb is armed (refer to chapter 22, Autoflight)
- The corresponding EFIS ILS pb is not illuminated

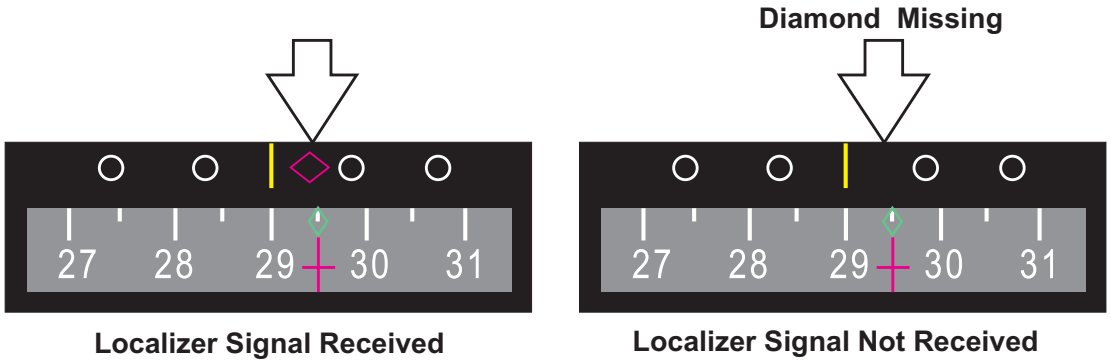
The flashing ILS is not displayed when the EFIS ILS pb is illuminated.

ILS Course Guidance

The magenta localizer and glide slope diamonds depict deviation from the selected course. With the EFIS ILS pb illuminated:

- The presence of the white scales indicate that an ILS frequency has been tuned
- The presence of the magenta diamond indicates that the associated signal is being received

The localizer and glide slope displays operate in a similar manner. The localizer display is shown below.



Localizer Signal Received

Localizer Signal Not Received

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ILS Receivers (continued)

ILS ND Displays

ILS information is also displayed on the ND in the ROSE ILS mode.

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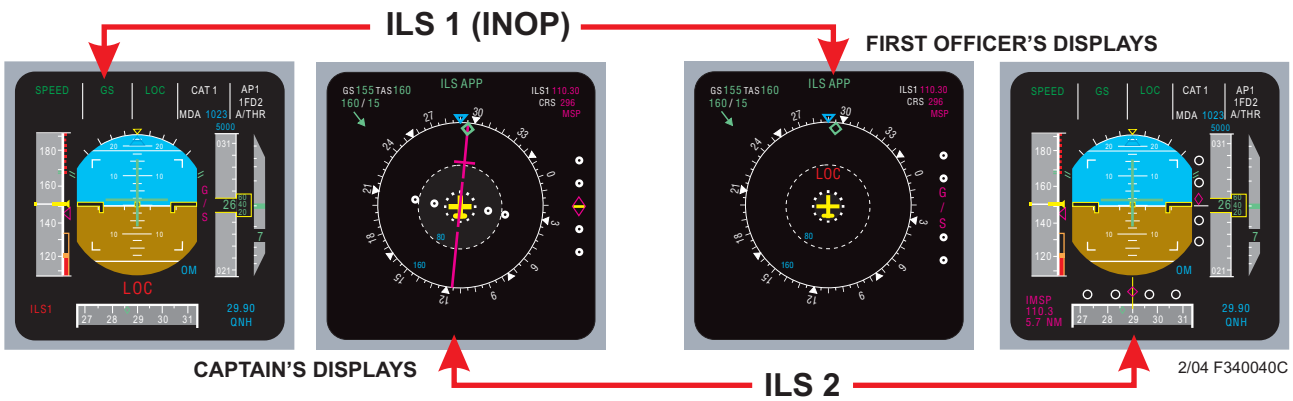
During a localizer back course approach, normal CDI sensing is displayed on the ND by entering the published front course via the MCDU (refer to MCDU Operations) or RMP (refer to Navaid Tuning, discussed later).

The ROSE ILS mode is discussed in detail in chapter 31, Flight Instruments.

ILS Receiver Failure

A red warning flag on the PFD and ND indicates a failure of the associated receiver. In the example below, ILS 1 has failed. In this case, ILS information is not available on the captain's PFD and the first officer's ND.



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In the example above (with GS and LOC modes engaged), the flight director command bars on both PFDs would be automatically coupled to the remaining ILS receiver, allowing either pilot to perform the approach. In this case, the captain can select the ROSE ILS ND mode to display raw ILS data.

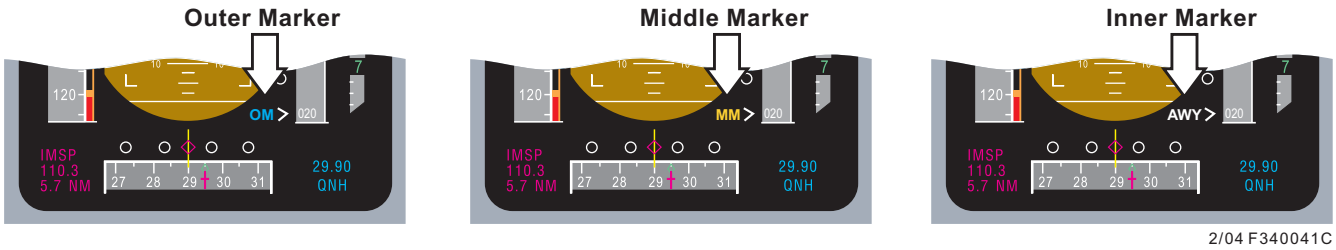
Marker Beacons

Description

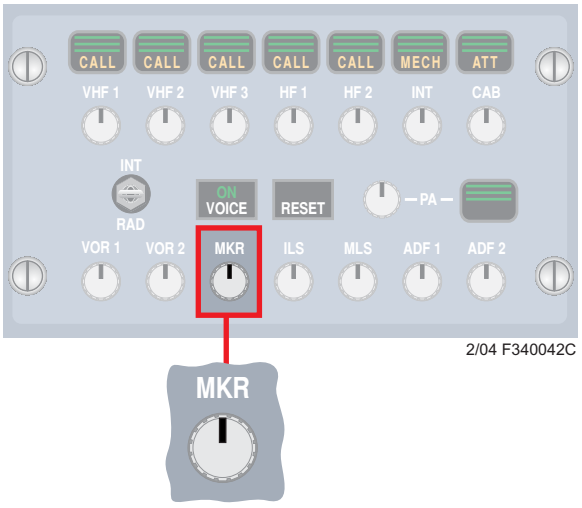
One marker beacon system is installed in the VOR 1 receiver. When received, the marker beacon symbol is always displayed on the PFD. The marker beacon is displayed as follows:

- A blue OM for the Outer Marker
- An amber MM for the Middle Marker
- A white AWY for the Inner Marker

For example, when the outer marker signal is received, OM is displayed on the PFD as shown below:



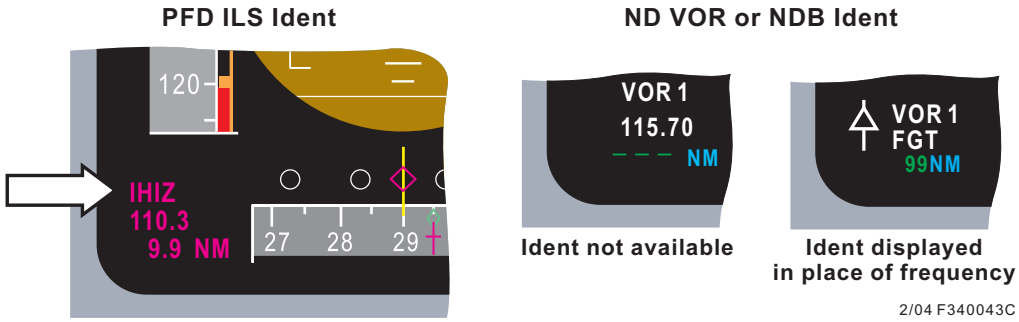
Marker beacon audio is selected on the Audio Control Panel (ACP), as described in chapter 23, Communications.



Navaid Identifier

Navaid Identifier

The Morse code identifier received from ILS, VOR, DME, and NDB navaids is automatically decoded. The decoded identifier is displayed on the PFD and ND, and will change to a new identifier if a different or stronger signal is received on that frequency. If the identifier is not received or decoded, the tuned frequency is displayed.

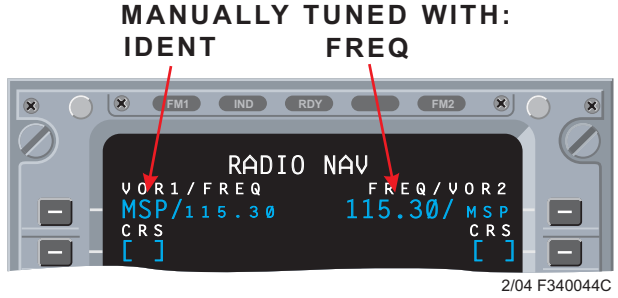


Identifier Displayed on MCDU RAD NAV Page

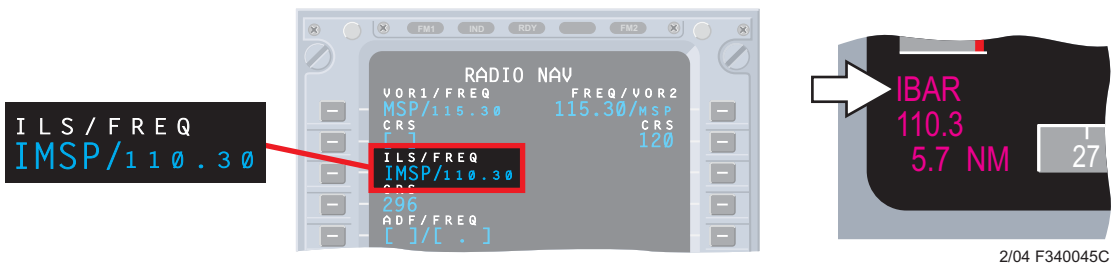
The pilot can tune a navaid via the MCDU by entering either the frequency or the identifier on the RAD NAV page.

Note: An ILS frequency may be tuned in the VOR field. This is done in order to get LOC DME for some departures. If this procedure is performed the identifier will not be displayed, only the frequency.

If the pilot enters an identifier on the RAD NAV page, the FMGC extracts the appropriate frequency from the data base corresponding to that navaid. In this case the identifier is displayed on the RAD NAV page in large font, and the frequency is displayed in small font. The receiver is then tuned to that frequency.



The identifier actually received is decoded and displayed on the PFD and ND, while the identifier used for tuning the navaid on the RAD NAV page does not change. Therefore, it is possible for the identifier displayed on the MCDU to be different from that displayed on the PFD or ND. In the example below, the pilot has tuned the IMSP ILS, with a frequency of 110.3. The identifier received on that frequency is different (e.g., IBAR), as shown on the PFD.



Navaid Tuning

General

Navigation radio tuning is normally accomplished either:

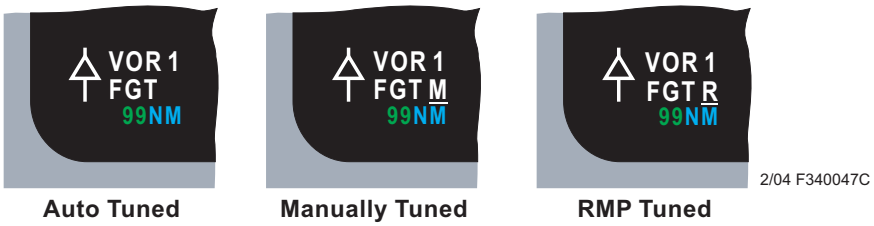
- Automatically by the FMGCs
- Manually by the pilot using the MCDU (refer to MCDU Operations)

In the event of dual FMGC failure, the pilot can tune the navaids using the STBY NAV tuning capability of the RMPs.

The method used to tune VOR/DME navaids is displayed on the ND using the following symbols:

- The lack of a symbol indicates automatic (FMGC) tuning
- An M indicates manual tuning
- An R indicates STBY NAV tuning using the RMPs

An example display of auto, manual, and RMP tuning is shown below:



Data Lock

During an ILS approach, the ILS frequency and/or course cannot be changed, either via the MCDU RAD NAV page or with the RMP, below a radar altitude of 700 feet. Any attempt to change the ILS frequency, even through the use of the secondary flight plan, will be ignored.

For example, many sidestep ILS approaches have minimums below 700 feet AGL. In these cases, the data lock feature requires the sidestep portion of the maneuver to be completed visually, without ILS localizer course guidance.

Automatic Navaid Tuning

General

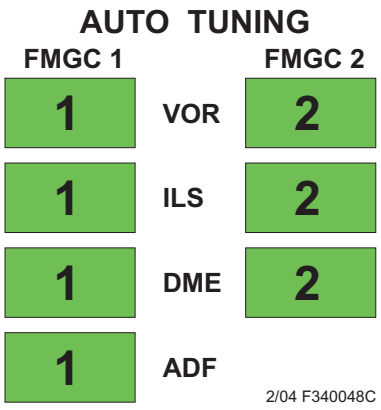
The FMS automatically tunes navigation radios for the following purposes:

- Localizer guidance during takeoff
- FMS radio navigation (position updating)
- En route VOR\DME display
- ILS, VOR, and ADF approach guidance

The FMS automatically tunes the navigation radios as follows

- FMGC 1 tunes the #1 radios
- FMGC 2 tunes the #2 radios

Note: Both ILS receivers are always tuned to the same frequency.



FMGC Failure

If one FMGC fails, the remaining FMGC tunes all receivers.

Ground Operations

VOR/DME autotuning begins when the IRS alignment (discussed later) is completed.

Note: On the Collins DDRMI (only), an amber VOR flag is displayed if a VOR signal is not received.

COLLINS

When a departure runway is entered in the flight plan via the MCDU, the associated localizer (if available) and course is autotuned. This provides lateral guidance for the RWY guidance mode (refer to chapter 22, Autoflight).

Automatic Navaid Tuning (continued)

En Route

Once airborne, each FMGC automatically tunes two DMEs to determine a radio position (refer to FMS navigation, this chapter). Each FMGC also automatically tunes a VOR/DME for display.

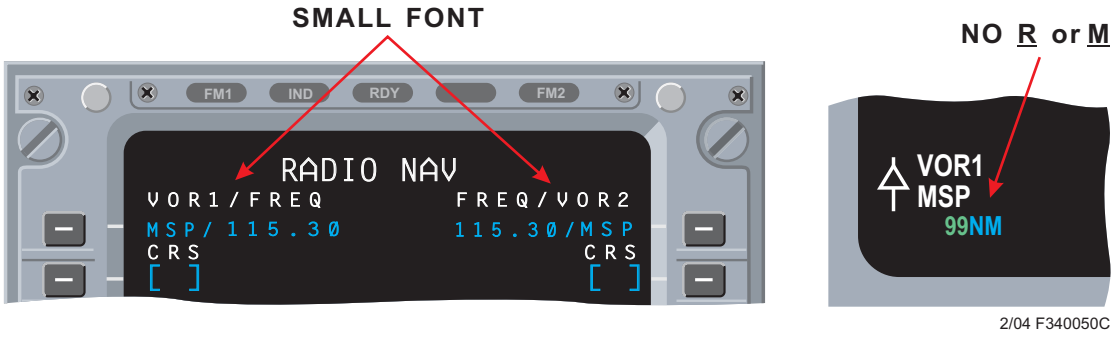
Up to five DME frequencies can be scanned simultaneously. This allows each FMGC to use two DMEs for navigation, an ILS DME (when appropriate), and a separate DME for display for each VOR.

The simultaneous DME capability is automatically provided for the FMGCs by:

- Multiple DME channels in each receiver
- Time sharing of the DME receiver antennas

The DME selected for display can be monitored on the ND. The other scanned DMEs can be monitored on the MCDU Selected Navaids (SEL NAVAIDS) page (refer to MCDU operations).

The pilot can recognize that a VOR/DME has been autotuned by noting the small font on the MCDU RAD NAV page and the lack of a M (Manual) or R (RMP) tuning symbol on the ND VOR/DME information block.



2/04 F340050C

Automatic Navaid Tuning (continued)

Approach

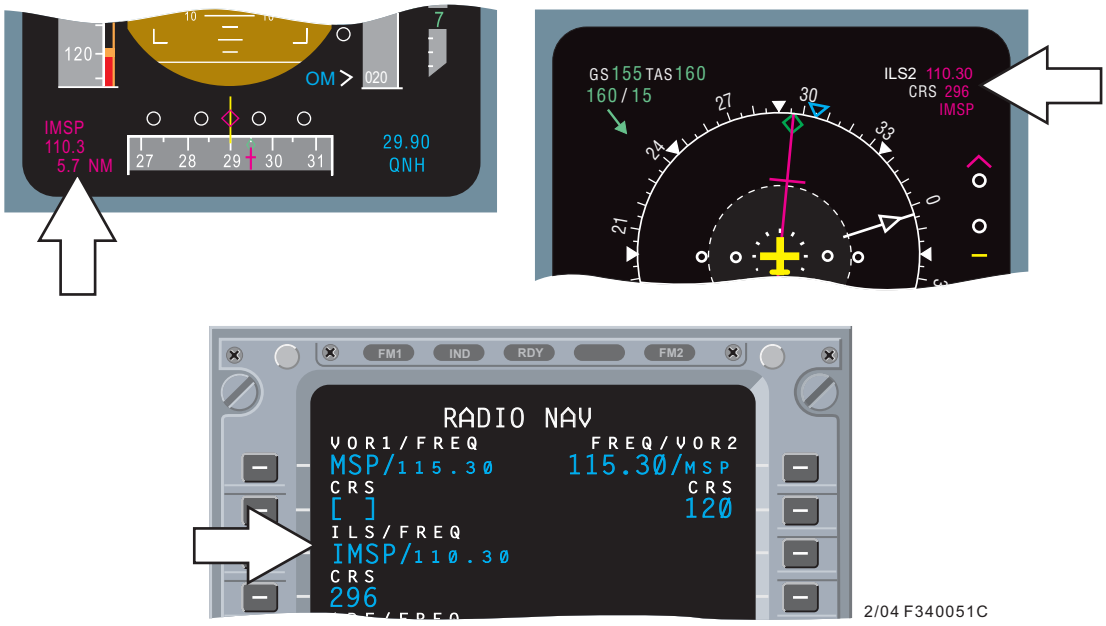
When an approach procedure is selected via the MCDU, the associated navaid (ILS, VOR, or NDB) is automatically tuned, as described in the following paragraphs. The approach procedure must be in the FMS data base (refer to FMS Data Base, this chapter) for autotuning to occur. Autotuning is inhibited if the pilot has previously manually tuned the approach navaid.

ILS Approach

When an ILS approach is selected, the FMGC autotunes the appropriate ILS frequencies and approach course. The associated DME frequency is also autotuned. The pilot can verify autotuning on the PFD, the ND, or the MCDU RAD NAV page.

Note: ADF frequencies associated with a compass locator are not autotuned and must be manually tuned.

For example, when the pilot selects the MSP ILS 30L approach via the MCDU (refer to MCDU operations), the appropriate frequencies and course are selected, as shown below:



Both ILS receivers are always tuned to the same frequency. Therefore only a single frequency and course for ILS is displayed on the respective MCDU RAD NAV page.

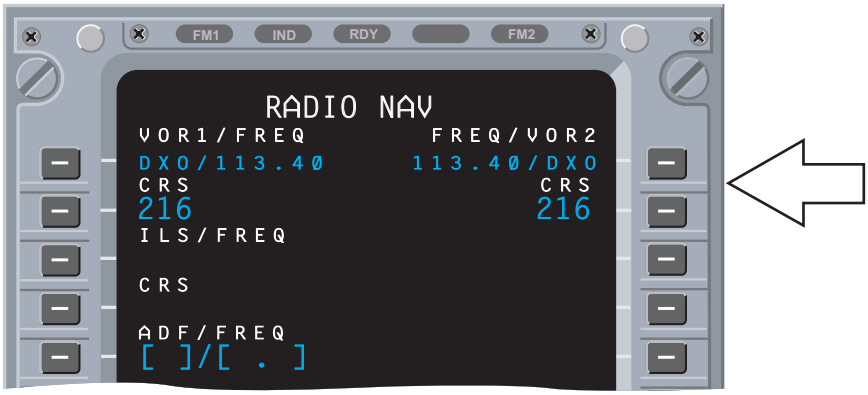
Automatic Navaid Tuning (continued)

Approach (continued)

VOR or VOR/DME

When a VOR or VOR/DME approach is selected from the FMS data base, the appropriate VOR/DME is autotuned when the first waypoint on that approach is the TO waypoint. The pilot can verify autotuning on the ND and the MCDU RAD NAV page.

For example, when the pilot selects the KDTW VOR 22R approach via the MCDU (refer to MCDU Operations), the appropriate frequency is selected, as shown below:



2/04 F340054C

If an ND ROSE VOR CDI display is desired, the final approach course must be manually selected.

ADF Approach

When an ADF approach is selected from the FMGC data base the appropriate ADF is autotuned when the first waypoint on that approach is the TO waypoint. If autotuned, the ADF is automatically deselected during a go-around.

Note: An ADF associated with a missed approach fix is not autotuned.

2/04 F340055C

Manual Navaid Tuning

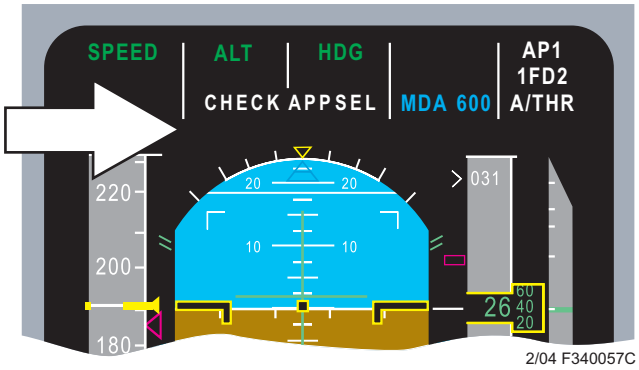
Description

The pilot can manually tune desired navaids via the MCDU (refer to MCDU Operations).

Manually tuning a navaid prevents the FMGC from autotuning the selected navaid for display purposes. For example, the pilot manually tunes the ILS to the frequency for runway 24L. The ILS approach for runway 24R is then selected via the MCDU. The FMGC cannot autotune the correct ILS frequency for runway 24R because the ILS has been manually tuned.

In this case the following MCDU message is displayed:

If an ILS frequency has been manually tuned, and the pilot selects a non-ILS approach from the FMS data base (a VOR approach, for example), the FCU APPR pb arms the FINAL and APP NAV guidance modes and the G/S and LOC modes are not available (refer to chapter 22, Autoflight). To ensure that the pilot receives the desired flight guidance, the PFD message ‘CHECK APP SEL’ is displayed when the aircraft is within 100nm of the destination, or when in the DES or APPR phase. Note: This message is displayed both on the PFD (illustrated below) and the MCDU scratchpad.

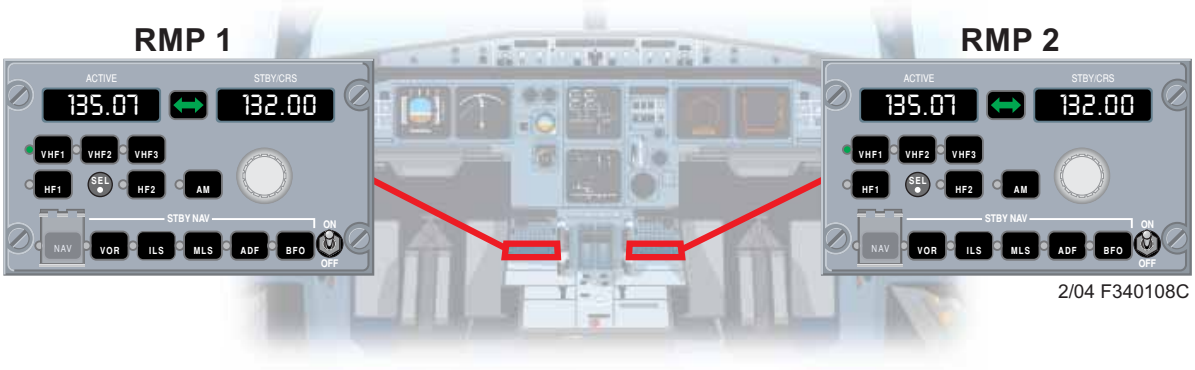


2/04 F340057C

Standby Navaid Tuning

Description

In the event both FMGCs fail, the navigation radios can be tuned using the STBY NAV tuning capability of the RMPs.



2/04 F340108C

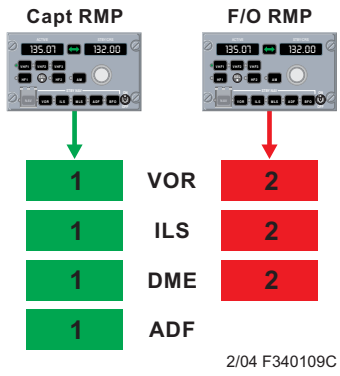
The RMP power switches must be on to use STBY NAV tuning.

The last frequency selected using standby navaid tuning is retained by each RMP until changed. RMP 1 and 2 can each tune their on-side receivers.

In the event an RMP has failed, standby navaid tuning of the associated navigation radios is not possible.

Both ILS receivers are always tuned to the same frequency. They can therefore, be tuned with either RMP.

The DME operates on the DME frequencies associated with the tuned VOR and ILS frequencies.



2/04 F340109C

Note: If STBY NAV is selected on either RMP, navaids cannot be tuned using either MCDU. The entry fields on the RAD NAV page are removed and (only the field titles remain).

2/04 F340110C

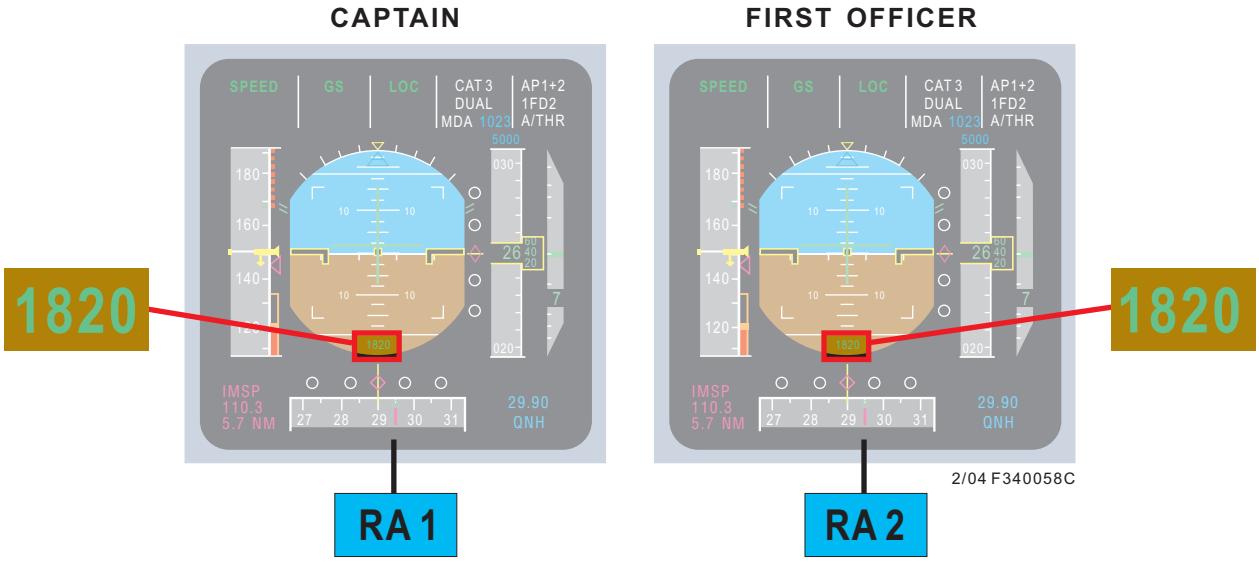
Radio Altimeters

Description

Two Radio Altimeters (RA) are installed. Radio altimeter height (AGL) is automatically displayed on the PFDs at lower altitudes. The radio altimeters are also integrated into the flight control system (refer to chapter 27, Flight Controls) and are required when performing automatic landings (refer to chapter 22, Autoflight). Radio altimeter PFD displays are discussed in detail in chapter 31, Flight Instruments.

Radio altimeter information is normally depicted on the PFDs as follows:

- RA 1 information on the captain's PFD
- RA 2 information on the first officer's PFD



Radio Altimeters (continued)

Automatic Voice Callouts

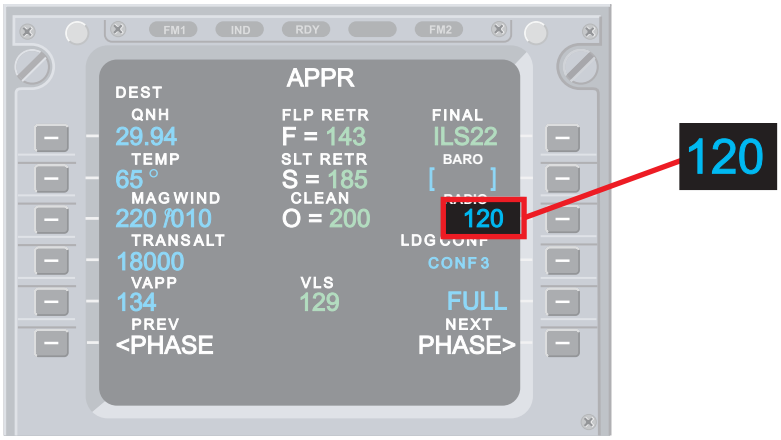
Automatic voice callouts occur during the landing flare, based on radio altimeter height. The callouts are generated through the loudspeakers even when the loudspeakers are selected off. These callouts are:

- ONE HUNDRED
- FIFTY
- THIRTY
- RETARD (at 20 feet)

Note: The RETARD callout occurs at 10 feet during auto landings (refer to chapter 22, Autoflight).

If the pilot enters a numerical value into the RADIO on the MCDU PERF APPR page (refer to MCDU Operations), two additional callouts are provided:

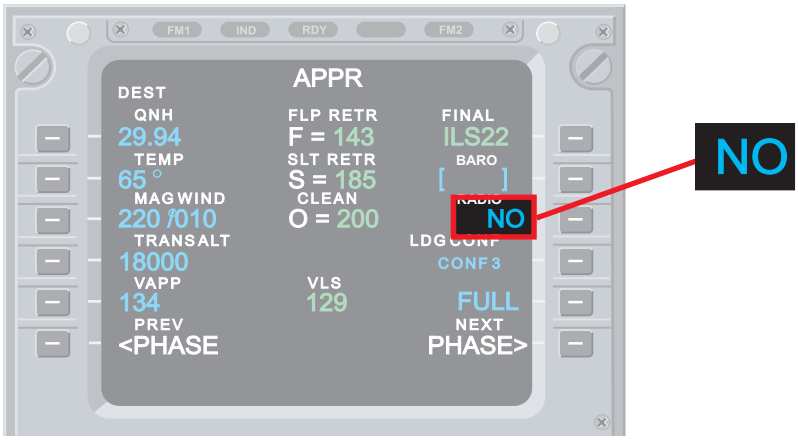
- ONE HUNDRED TO MINIMUMS
- MINIMUMS



DALF340059C

This will occur, for example, during a CAT II approach using radio altimeter minimums.

These additional callouts do not occur when NO is entered in the MCDU for an alert height during a CAT III approach.



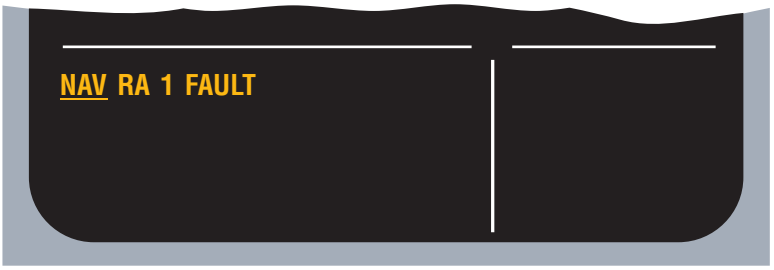
DALF340060C

Radio Altimeters (continued)

Radio Altimeter Failure

Single Failure

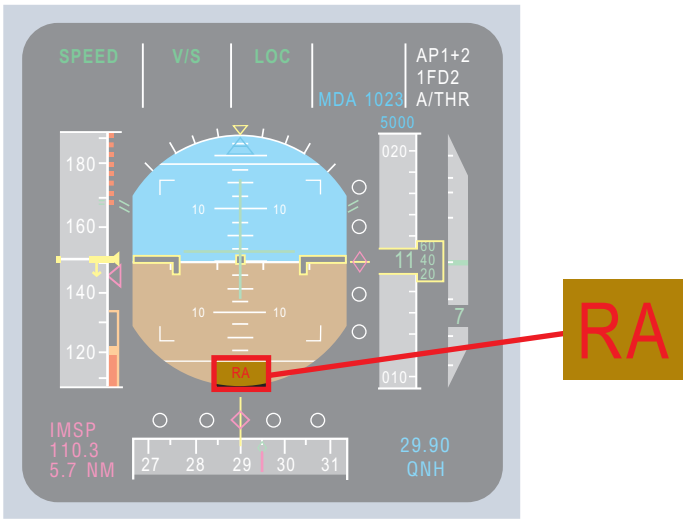
If one radio altimeter fails, the remaining radio altimeter automatically provides information on both PFDs. An ECAM memo is provided to indicate this failure, as shown below:



2/04 F340061C

Dual Failure

If both radio altimeters fail, red RA warning flags appear on both PFDs.



2/04F340063C

This failure results in the following:

- During ILS approaches, the FCU APPR pb will not arm and the LAND flight guidance mode is not available (refer to chapter 22, Autoflight). The flight guidance does not couple to the ILS glide slope and the G/S vertical mode is not available. Auto landings are not possible.
- Flight controls remain in normal law and revert to direct law when the landing gear is extended (refer to chapter 27, Flight Controls).

Transponders

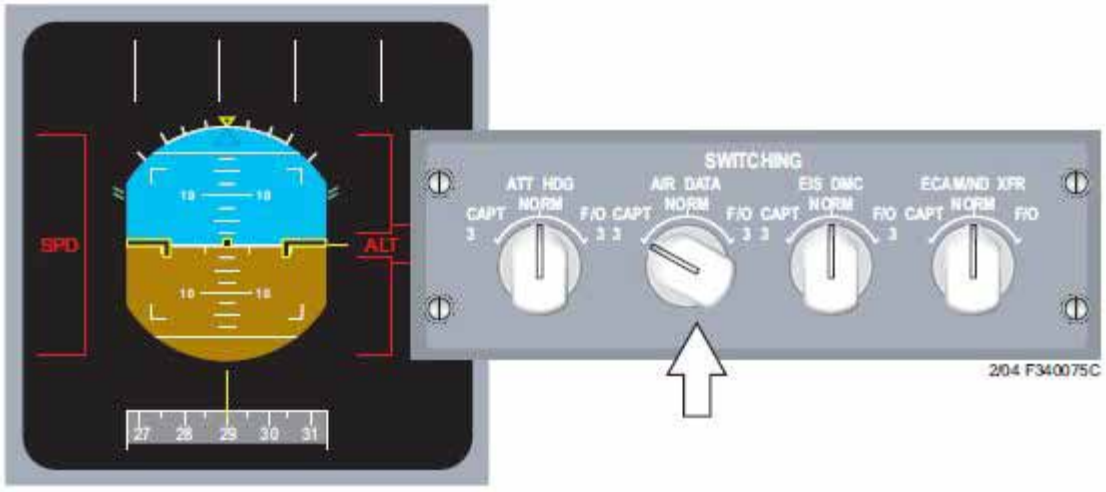
Description

Two ATC transponders are installed. The transponders are selected with the ATC control panel on the pedestal and operate one at a time.

The altitude reporting capability (Mode C) is provided by the Air Data Reference (ADR) system (discussed later) associated with the transponder. For example:

- When transponder 1 is selected, ADR 1 provides the altitude signal
- When transponder 2 is selected, ADR 2 provides the altitude signal

In the case of an ADR failure, the failed ADR is substituted with ADR 3 by the AIR DATA Selector on the ECAM switching panel (refer to ADIRU Backup, discussed later). In the example below, ADR 1 has failed and ADR 3 has been selected as a backup.



Note: In the above case the Mode C will operate normally after ADR 3 has been selected, because all data is replaced by ADR 3.

Radar

Description

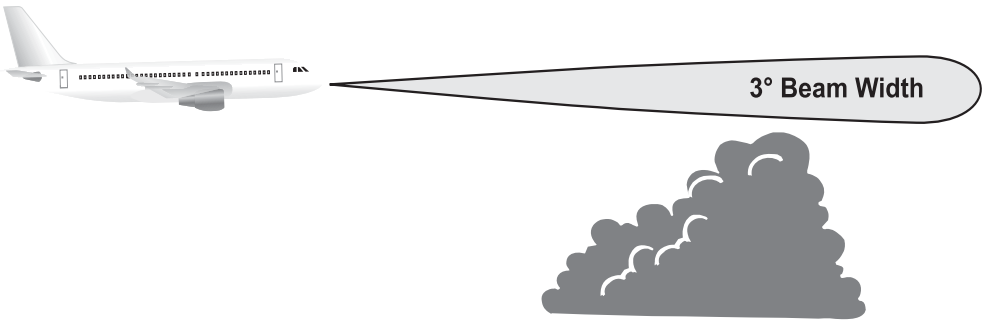
The A320 and A319 are equipped with a solid state Collins WRT-701X color weather radar system which utilizes Doppler technology to detect and display areas of light to heavy precipitation, as well as turbulence and ground mapping.

The system incorporates a Flat-Plate antenna producing a much narrower beam (3 degrees) of energy compared to traditional Parabolic antennas. This results in better precision at longer ranges but requires more tilt and gain management, especially at the higher altitudes.

Weather radar images can be simultaneously displayed and independently controlled on either Navigation Display (ND) without interfering with navigation route displays.

Note: Weather radar images are inhibited from a ND when the associated ND is in the PLAN mode.

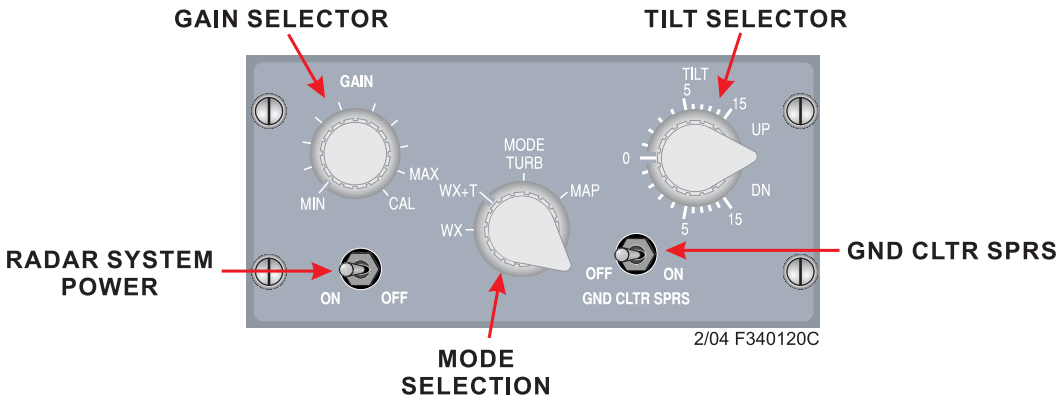
Radar antenna stabilization is automatically maintained by the aircraft's Inertial Reference System (IRS). Therefore, the antenna's 180 degree sweep is always perpendicular to the vertical reference, which continuously compensates for the aircraft's pitch and roll attitudes.



DALF340391a

Radar Control Panel

The weather radar system's operation is controlled from the Radar Control panel located on the left aft portion of the center pedestal.

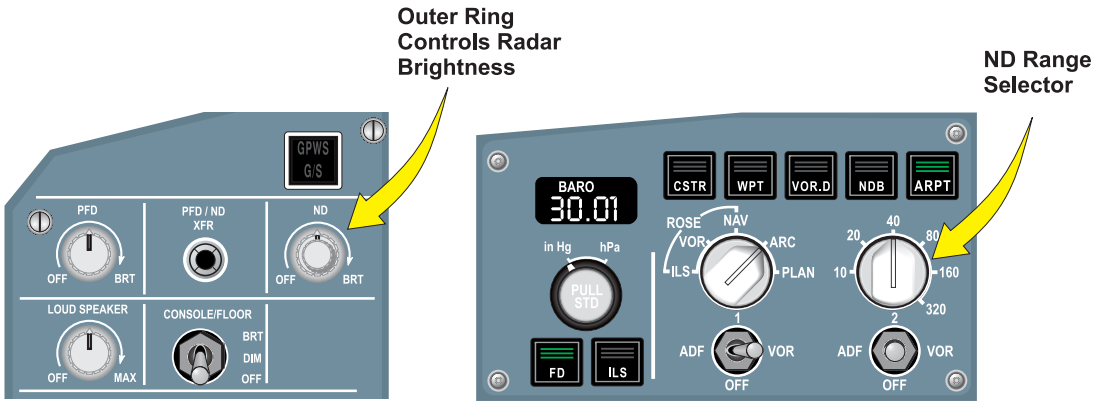


2/04 F340120C

Radar (continued)

ND Radar Display Controls

The brightness of weather radar displays and display range settings are controlled from a brightness control selector and a ND range selector, located on the outboard section of each forward instrument panel and the EFIS panels, respectively.



EFIS Panel F310271a

Display Colors

The color of the radar images indicates precipitation intensity as follows:

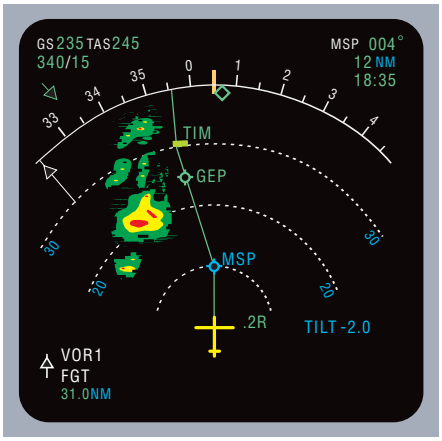
Black - minimum intensity

Green - low intensity

Amber - moderate intensity

Red - higher intensity (saturation)

Magenta - significant turbulence



2/04 F340003C

Radar Operation and Self-test

Unlike more traditional radar systems, when selected ON, the Collins Radar system is immediately activated and begins scanning with no warm-up time required.

Caution: *Do not activate the radar until clear of the gate area and personnel.*

When first turned ON, the system performs an automatic self-test which takes 45 seconds to complete. The self-test does not interfere with the radar's operational capabilities. Following the self-test, any critical malfunctions will be annunciated on the Navigation Displays. In addition to the initial self-test, the system performs a quick self-test at the end of each antenna sweep.

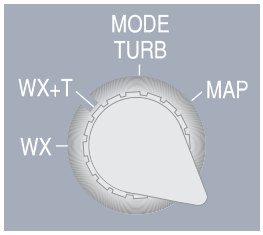
A list of all possible failure displays are located in the aircraft COM section 2.34.

Note: Weather radar malfunctions are not monitored by the ECAM system. All fault indications are presented on the ND screens.

Radar (continued)

Modes of Operation

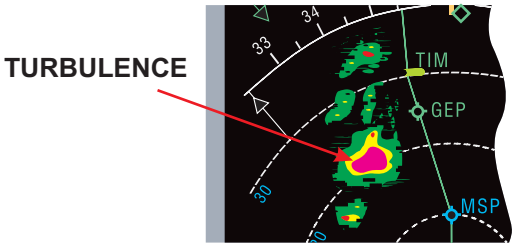
The radar system's operational modes are selected with the MODE selector located on the Radar Control panel.



F340394a

WX - Weather mode - displays are only associated with precipitation.

WX+T - Weather and Turbulence mode - displays are associated with precipitation and areas of significant turbulence.



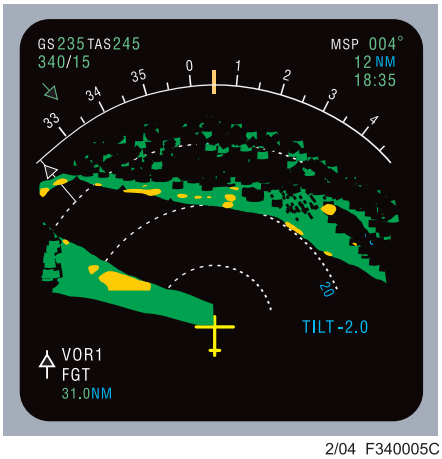
2/04 F340066C

Note: To display turbulence (**magenta** returns), the ND range must be set at 40 NM or less.

TURB - Turbulence mode - displays only represent areas of significant turbulence (Magenta only). The range must be set at 40 NM or less.

MAP - Map mode (Ground Mapping) - display colors represent the following:

- Black for water (or radar shadows)
- Green for ground
- Amber for man-made structures or high terrain



2/04 F340005C

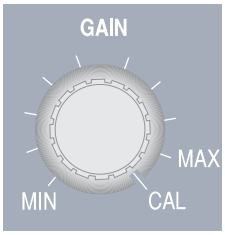
Radar (continued)

Gain Control

The radar's energy beam strength is controlled by the GAIN selector located on the Radar Control panel. A detent CAL (Calibrated) position provides a predetermined energy level.

Moving the selector out of the CAL detent allows for manual control of the beam's strength. When out of the CAL position the annunciation MAN appears on the ND. Manual selections range from MIN to MAX. Selecting MAX increases the beam's strength by 3000%.

Note: The CAL position may not always provide the optimum beam power setting for a given weather condition.



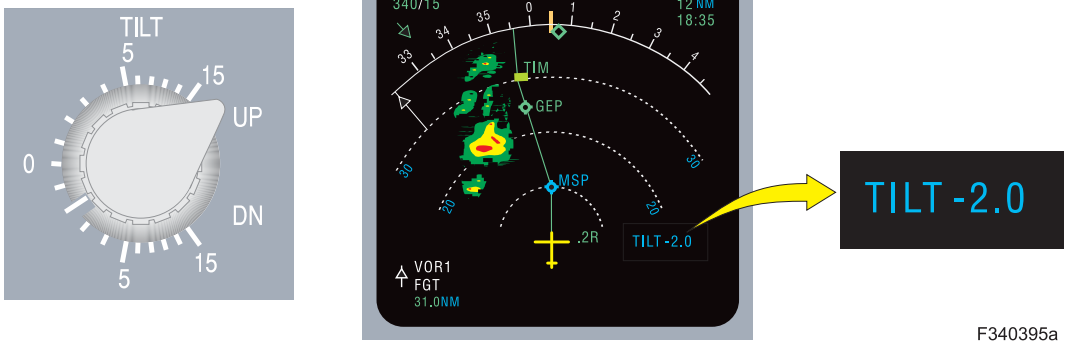
F340393a

Note: Manual gain adjustments will never provide a beam strength lower than that available in the CAL position. Therefore, selections made in the manual mode will always result in an increased beam strength.

Note: It is recommended to use the manual gain settings to evaluate weather displays when the aircraft is above FL250.

Antenna Tilt Control

The TILT knob on the Radar Control panel is used to adjust the antenna's tilt angle +/-15 degrees from the aircraft's pitch axis. A setting of zero represents the horizon as defined by IRS 1. The amount and direction of selected tilt is displayed on the NDs.



F340395a

Note: Due to the narrow energy beam (3 degrees), at the higher altitudes a low altitude storm detected on the longer range settings may disappear from the display as the aircraft approaches it. Judicious tilt management prevents over-scanning a weather target.

Radar (continued)

Ground Clutter Suppression

The Ground Clutter Suppression feature allows the pilot to eliminate approximately 85% of ground clutter targets that may appear during normal precipitation detection modes. It is activated by holding the spring-loaded GND CLTR SPRS switch to the ON position. When released, the switch returns to the OFF position.

F340396a

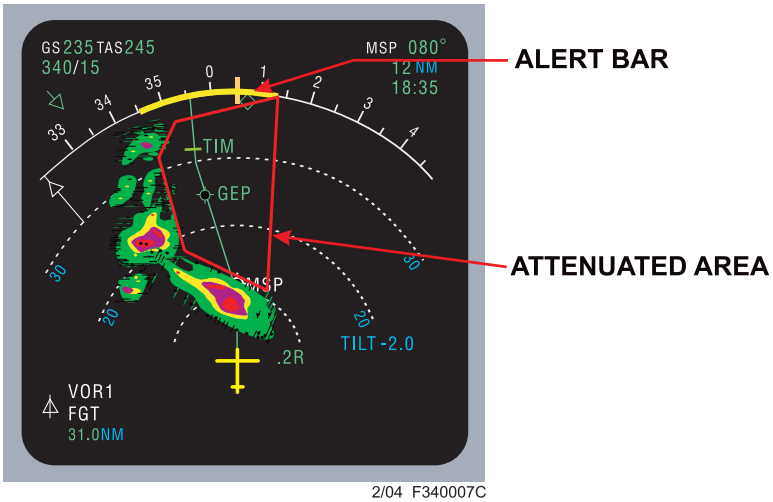
Note: When active, the Ground Clutter Suppression feature identifies ground targets in a manner similar to the Turbulence Mode (Magenta). Therefore, it is possible for some weather targets to be incorrectly identified. It is recommended that this function only be used for short periods, and the Tilt should be limited from 0 to 5 degrees down.

Path Attenuation Correction (PAC)

When the radar detects very heavy precipitation, the strength of the radar's beam can be weakened, this is referred to as "Beam Attenuation". In such an event, areas of weather beyond the attenuated area may not be displayed.

To alert the pilot of areas of attenuation, a yellow alert bar appears at the top of the ND where the attenuation has been detected. This feature is referred to as Path Attenuation Correction Path (PAC).

Note: The alert bar will only be displayed when the GAIN control is set to CAL and intervening weather is within 80 NM of the aircraft.

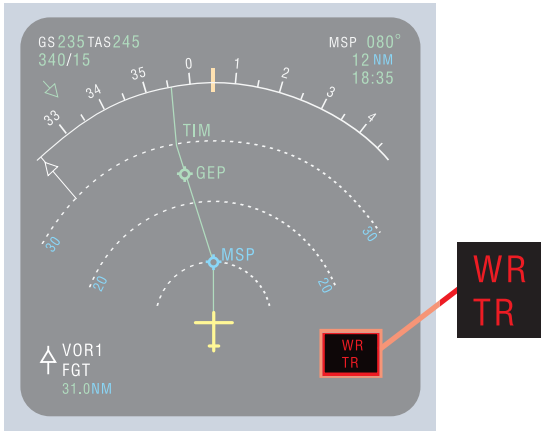


2/04 F340007C

Radar (continued)

Radar Malfunction Indications

All radar system malfunctions are displayed on the Navigation Display screens. A list of all possible malfunction displays is located in the COM section 2.34.

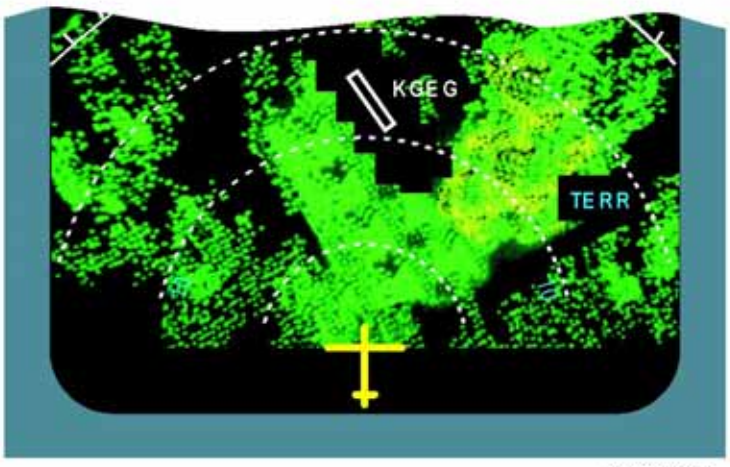


2/04 F340067C

EGPWS

The TERRAIN/OBSTACLE alert feature of the Enhanced Ground Proximity Warning System EGPWS has an automatic priority over the weather radar display. When the EGPWS Terrain Display is selected or a Terrain Alert has been triggered (Pop-Up), the weather radar display is suppressed and replaced with the terrain map display.

To aid the pilot in differentiating between weather radar displays and terrain displays, whenever terrain is being displayed, the annunciation TERR appears on the ND. (See chapter 85 for additional information concerning EGPWS operation).



1/98 F8500780

Note: Weather radar may be displayed on one ND, while Terrain is displayed on the other. However, in the event of an EGPWS TERRAIN/OBSTACLE warning, both NDs will display Terrain.

Air Data Inertial Reference System (ADIRS)

General

Three Air Data Inertial Reference Units (ADIRUs) are installed. The ADIRU is a combination of an Air Data Reference (ADR) unit and an Inertial Reference Unit (IRU). The three ADIRUs comprise the Air Data Inertial Reference System (ADIRS). The ADIRS provides information to numerous aircraft systems including the flight management system, flight control computers, EFIS displays, engine controllers, and transponders.

The ADIRUs are electrically supplied by:

- Main aircraft power
- Aircraft battery power as a backup

Theory of Operation

Each IRU utilizes a set of ring laser gyros to sense rotation about the aircraft's three axes (including movement due to the Earth's rotation) and accelerometers to sense g-force and changes in velocity. Prior to flight each IRU must be aligned while the aircraft is stationary. During alignment, the IRU determines its attitude, true north orientation, and latitude. Starting from a known point (verified by the crew during alignment), the IRUs constantly monitor changes in velocity and direction and determine a three dimensional position as the sum of all the changes since alignment. Each IRU continuously and independently determines the aircraft attitude, true heading, track, velocity (ground speed and vertical speed), and present position. Magnetic heading is determined by correcting the true heading for the variation stored in the database for the current position.

Comparing the inertial values of ground speed, track, against the heading and true airspeed yields a wind value.

The IRU's are very accurate, but the accuracy does degrade slowly over time. In normal operation, the IRUs each use radio position data (if available) to refine the FMS position for navigation. Additional information on FMS positioning, refer the FMS portion of this chapter.

GPS: In aircraft with a Hybrid architecture the three IRUs use GPS to calculate a hybrid GPIRS position which is then sent to FMS 1 and 2. In aircraft with an Autonomous architecture both the IRU and GPS positions are sent to FMS 1 and 2. The FMS then uses a filter to correct the IRU positions to determine the best mixed FMS position.

ADR Unit

The Air Data Reference (ADR) portion of the ADIRU provides airspeed, mach, barometric altitude, and backup vertical velocity information to the EFIS displays and numerous other systems. For example, the ADRs provide the Air Traffic Control (ATC) transponder with an altitude signal, and provide the engine Full Authority Digital Engine Control (FADECs) and flight control computers with altitude and airspeed information.

The ADR section of the ADIRU receives inputs from the following sources:

- Pitot tube probes
- Static ports
- Total air temperature probes
- Angle of attack sensors

Air Data Inertial Reference System (ADIRS) (continued)

ADR Unit (continued)

Each ADR has an independent set of inputs. The ADR converts the inputs to electrical signals for use by other systems.

The ADR sources are protected from icing conditions by integral heating (refer to chapter 30, Ice and Rain Protection).

ADR Display

Information from the ADRs is displayed on the PFDs, NDs, and ECAM System Display (SD). Information is displayed as follows:

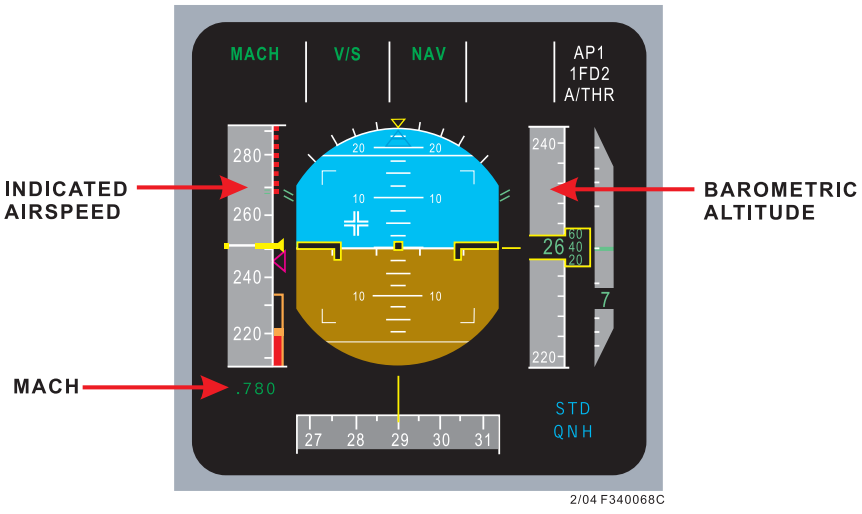
- ADR 1 on the captain's PFD and ND
- ADR 2 on the first officer's PFD and ND

ADR 3 is available to backup either ADR 1 or 2 by using the ECAM switching panel (discussed later).

ADR information is also displayed on the ECAM SD page.

ADR information is depicted on the flight instruments as follows:

- PFD
  - Indicated airspeed
  - Mach
  - Barometric altitude
  - Backup vertical velocity (barometric), discussed on next page.



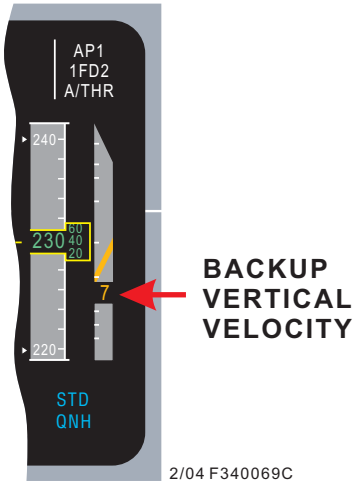
2/04 F340068C

Air Data Inertial Reference System (ADIRS) (continued)

ADR Information Display (continued)

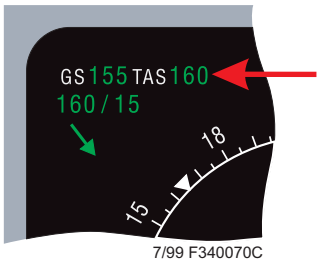
PFD vertical velocity information is normally provided by the Inertial Reference Unit (IRU).

The ADR automatically provides backup barometric vertical velocity on the PFD in the event of an IRU failure. The pilot can recognize backup vertical velocity by the amber box around the digital vertical velocity indication. The backup vertical velocity information provided by the ADR is similar to previous generation aircraft and will lag during significant attitude changes.



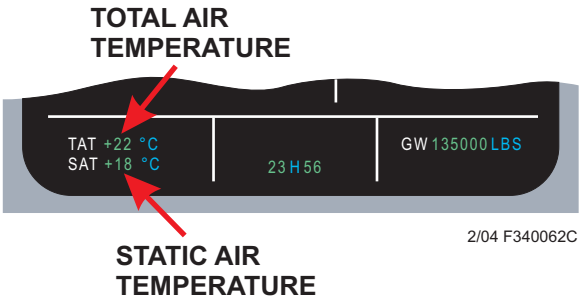
2/04 F340069C

- Navigation Display (ND)
  - True airspeed (TAS)



7/99 F340070C

- Systems Display (SD)
  - Total Air Temperature (TAT)
  - Static Air Temperature (SAT).



2/04 F340062C

Air Data Inertial Reference System (ADIRS) (continued)

Inertial Reference System

The Inertial Reference System (IRS) consists of the three IRUs. Prior to flight, each IR must determine the aircraft's attitude and velocity, and be given an initial present position. This process is called an “IRU alignment.”

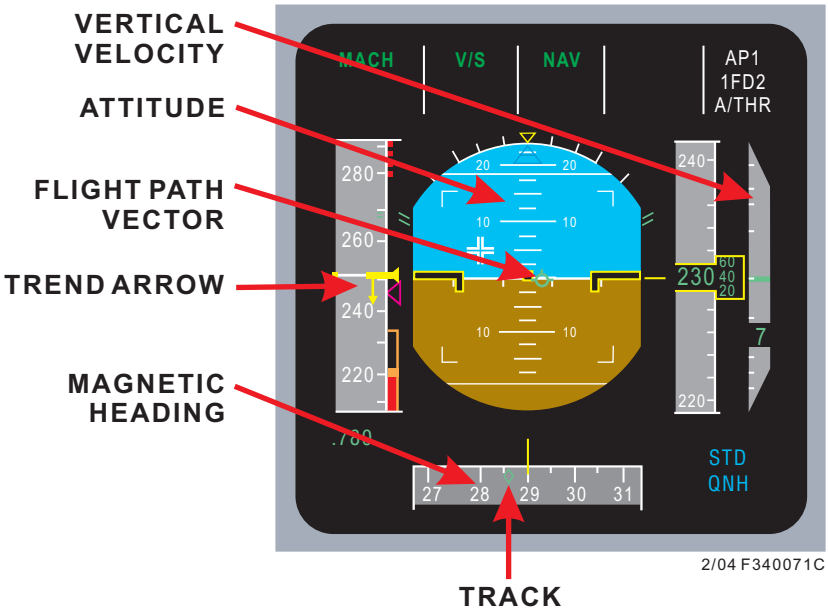
The IRU provides aircraft attitude (pitch, roll, yaw), heading, and inertial (instantaneous) vertical velocity information to the EFIS displays.

Each IRU is completely independent. IRU positions are used by the FMGCs in calculating the aircraft position. The IRUs also provide aircraft attitude, velocity, and other information to the flight control system. The loss of two or more IRUs results in many significant degradations including a degradation of flight control laws and protections, and loss of autopilots, flight directors, and autothrust.

IRU Information

IRU information is displayed on the PFDs, the NDs, and the DDRMI.

- PFD
  - Attitude
  - Vertical velocity
  - Flight path vector (refer to chapter 22, Autoflight)
  - Magnetic heading
  - Track



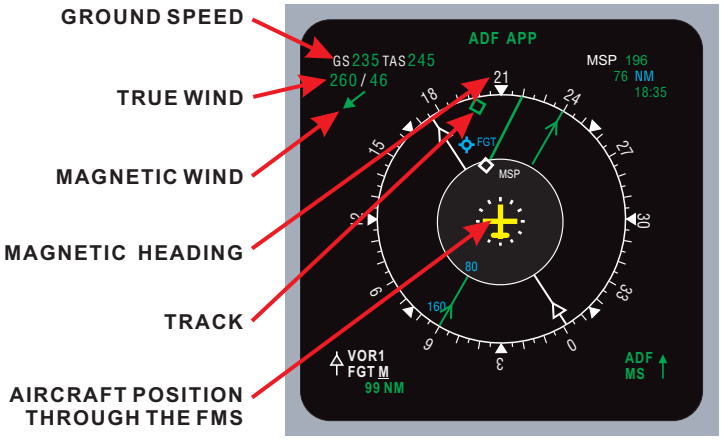
Air Data Inertial Reference System (ADIRS) (continued)

IRU Information (continued)

- ND
  - Magnetic heading
  - Ground speed
  - True wind
  - Magnetic wind (relative to the aircraft's heading)

Note: The headwind or tailwind component of the magnetic wind is displayed when the indicated airspeed reaches 100 kts during the takeoff roll.

  - Track
  - Aircraft position through the FMS (discussed later).



2/04 F340072C

- DDRMI
  - The heading source for the DDRMI is the same as for the captain's PFD (normally IR 1).

2/04 F340073C

Air Data Inertial Reference System (ADIRS) (continued)

ADIRU Backup

If the IRU or ADR portion of an ADIRU fails, the PFD, ND, and DDRMI information can be replaced by ADIRU 3.

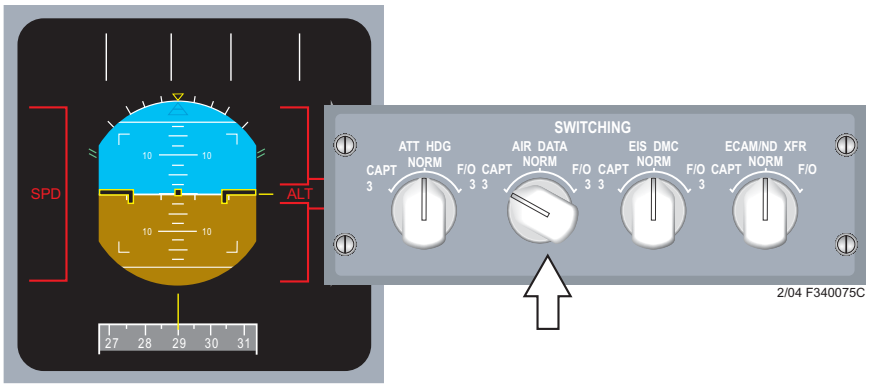
ADR Backup

ADR 3 can backup either ADR 1 or ADR 2. In NORM the AIR DATA selector supplies:

- ADR 1 data to PFD 1, ND 1, and transponder 1
- ADR 2 data to PFD 2, ND 2, and transponder 2

Selecting CAPT ON 3 or F/O ON 3 replaces either ADR 1 or ADR 2 with ADR 3 respectively.

Example: If ADR 1 fails, the SPD and ALT messages are displayed on the captain's PFD. ADR data can be restored by rotating the AIR DATA selector to CAPT ON 3.



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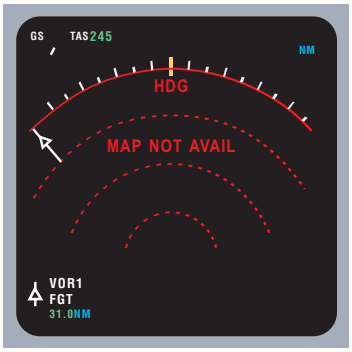
IRU Backup

IRU 3 can backup either IRU 1 or IRU 2. In NORM the ATT HDG selector supplies:

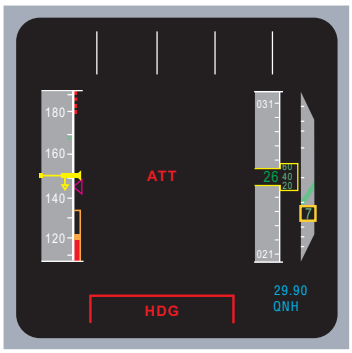
- IRU 1 data to PFD 1, ND 1, and the DDRMI
- IRU 2 data to PFD 2 and ND 2

Selecting CAPT ON 3 or F/O ON 3 replaces either IRU 1 or IRU 2 with IRU 3 respectively.

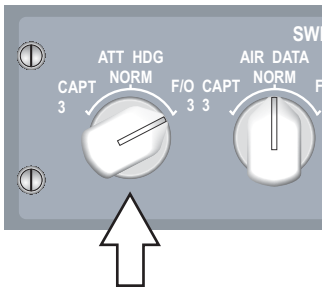
Example: If IRU 2 fails, the ATT HDG and MAP NOT AVAIL messages are displayed. IRU data can be restored by rotating the ATT/HDG selector to F/O ON 3.



3/04 F340078C



3/04 F340077C



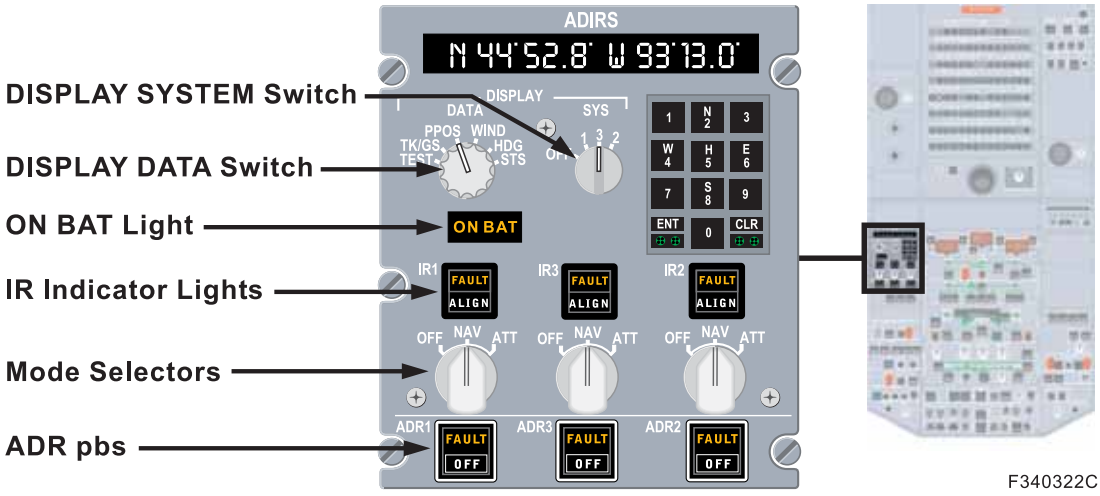
Air Data Inertial Reference System (ADIRS) (continued)

ADIRS Control

The ADIRS is controlled through the Control and Display Unit (CDU) and entries on the MCDU. The CDU incorporates controls for both the IRs and ADRs. The CDU includes:

- Three Mode Select Units (MSUs)
- IR fault and align lights
- The keypad
- The CDU annunciator
- The on battery power (ON BAT) light
- The display data switch
- The display system switch
- The ADR pbs which include integral fault and off lights

A complete discussion of the CDU controls is in section 34.20.



F340322C

Inertial Reference Unit Alignment

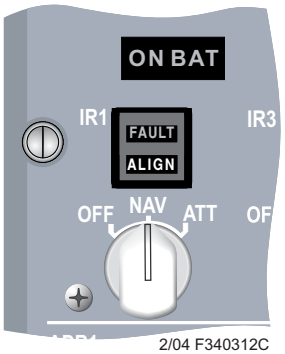
General

The IRU must be aligned before it can function. During an IRU alignment, the IRU determines the aircraft attitude, latitude, and true heading. The pilot provides the IRU with an initial position (latitude and longitude, or LAT/LONG) during the alignment. Once aligned, the IRU determines the change in position since the alignment, and constantly computes the present position (LAT/LONG) of the aircraft.

An alignment must be accomplished with the aircraft parked. Movement of the aircraft during the alignment phase causes the alignment to fail. Sufficient buffeting of the aircraft due to high winds or other motion may cause the alignment to automatically reinitiate.

Alignment Initiation

An alignment is initiated by selecting NAV on the Mode Select Unit (MSU). All three IRUs may be aligned simultaneously. When NAV is selected, the 10 minute alignment process is started and the ALIGN light illuminates, as shown below:



2/04 F340312C

A green ECAM E/WD memo is displayed with a countdown clock showing the time remaining until the completion of the alignment. The memo begins a countdown at seven minutes.

2/04 F340081C

The memo becomes amber if an engine is started, reminding the crew not to move the aircraft until the alignment is complete.

2/04 F340082C

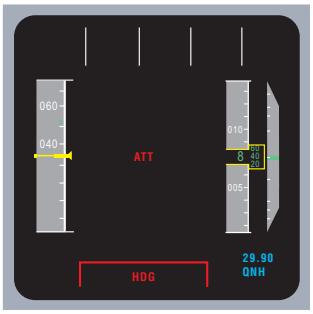
Inertial Reference Unit Alignment (continued)

Alignment (continued)

It is not necessary for the pilot to monitor the alignment process, as the process is automatic. However, if desired, the alignment can be monitored on the EFIS displays (PFD, ND, DDRMI) and MCDU.

PFD

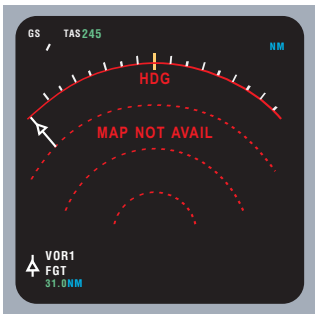
The PFD displays a red ATT flag until the IRU determines the aircraft attitude. The red HDG flag is displayed until a magnetic heading is determined (discussed later). The airspeed, altitude and backup vertical velocity scales appear almost instantly as each ADR is powered when the MSU is selected to NAV.



3/04 F340083C

ND

The ND displays a red HDG flag until the magnetic heading is determined. The red MAP NOT AVAIL flag is also displayed for the same reason.



3/04 F340078C

DDRMI

A HDG flag is displayed until the magnetic heading is determined. The VOR flags are always displayed when the HDG flag is displayed.

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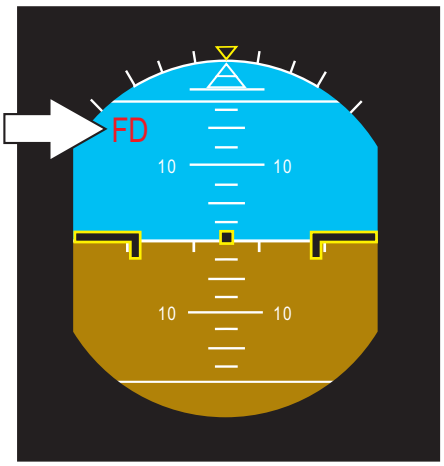
MCDU

During the alignment process, the MCDU POSITION MONITOR page displays ALIGN for each IRU, as shown below.

Inertial Reference Unit Alignment (continued)

Attitude Determination

The IRU determines the aircraft attitude after approximately 30 seconds. With the attitude indicator displayed, a red FD flag is displayed until at least two IRUs have finished the alignment. The PFD indication is shown below:



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Alignment Completed

When the alignment is complete, the E/WD memo is cleared, the CDU align light extinguishes, and all associated warning flags are removed from the PFDs, NDs, and DDRMI. No switch action on the MSU is required.

Inertial Reference Unit Alignment (continued)

Present Position Entry

The IRUs require a present position entry to complete the alignment. This initial position becomes the navigational starting point for the IRUs, allowing them to determine the aircraft position during flight.

Present position for all three IRUs is entered simultaneously, and can be entered any time after the alignment has been initiated. If more than 9 minutes have elapsed since the alignment was initiated, the white ALIGN lights on the CDU flash, reminding the pilot to enter the present position.

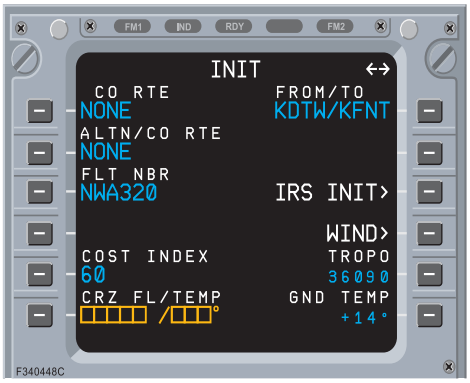
The present position entry can be accomplished using one of three methods:

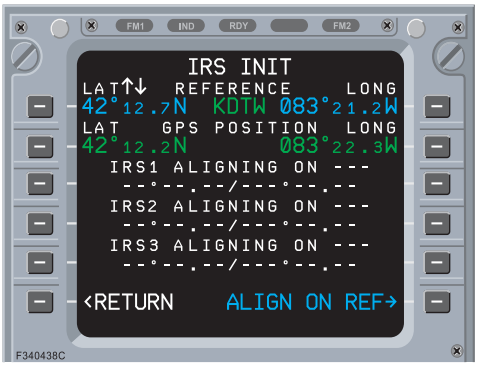
- Normal
- Alternate
- Using the CDU keypad

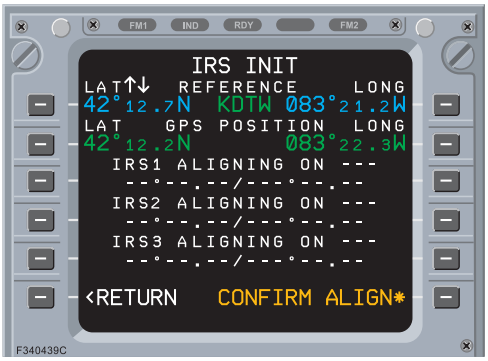
Note: To prevent excessive drift, the present position must be entered within 15 minutes of initiating the alignment.

Normal Entry

Upon entry of the FROM/ TO fields on INIT page A, the IRS INIT page displays the LAT/ LONG of the of the Airport Reference Point and the FROM airport's ICAO identifier. GPS position is displayed on line 2.





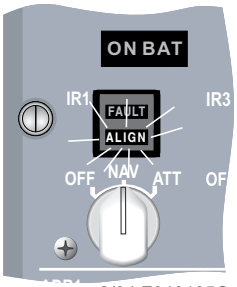


In order to begin the alignment process, the pilot must first verify that the Reference LAT/LONG displayed on line 1 matches that of the Departure Airport's Airport Reference Point. It is not necessary to modify the reference position to match the GPS position. IRS alignment is accomplished by selecting the ALIGN ON REF and CONFIRM ALIGN prompts at LSK [6R]."

Inertial Reference Unit Alignment (continued)

Present Position Entry (continued)

Note: If the ADIRS CDU align lights flash after entering the coordinates, a large error may exist. Confirm that the correct departure airport has been entered (refer to Present Position Memory, discussed later) and that the present position coordinates are correct.



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Alternate Entry

Due to the potential for error, the Normal method of present position entry should be utilized.. If necessary, however, the pilot may use an Alternate method of present position entry and modify the reference coordinates. To modify the LAT, the pilot must first press LSK [1L], then use the scroll arrows **(↑↓)** to change the latitude coordinate. In order to modify the LONG, the pilot must first press LSK [1R], then use the scroll arrows to change the longitude coordinate.

The reference position may also be entered via direct entry into the MCDU scratchpad and selecting the appropriate LSK [1L or 1R]. The latitude and longitude entries must be made separately. An "N" or "S" is required for the latitude entry, and an "E" or "W" is required for the longitude entry.

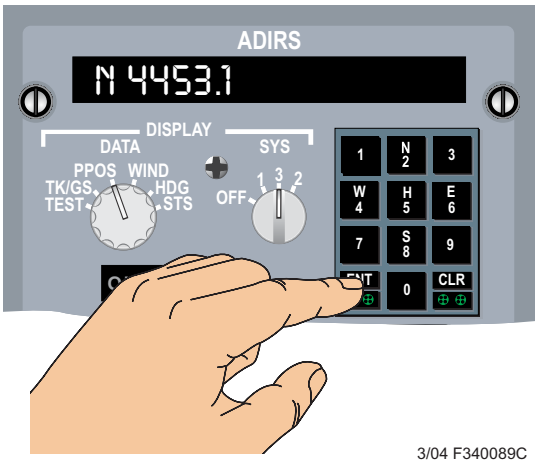
Once the reference position has been modified, the alignment process is initiated after the pilot selects the ALIGN ON REF and CONFIRM ALIGN prompts at LSK[6R].

Inertial Reference Unit Alignment (continued)

Present Position Entry (continued)

CDU Entry

The present position can also be entered via the CDU. Entering the present position on one IRU simultaneously enters the same coordinates in the other two. PPOS is selected on the display data knob and one of the IRS is selected with the system (SYS) display knob. The coordinates are typed directly into the CDU keypad. The latitude entry must start with a N or S as appropriate. The longitude entry is made separately in a similar manner, starting with a E or W as appropriate. An example is shown below:



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Caution: *Coordinates must be verified carefully before entry. Any error in coordinates is simultaneously entered in all three IRUs.*

Magnetic Heading

The IRUs compute true heading automatically. The IRU heading displayed on the CDU is always true heading.

When the IRU alignment is complete, true heading is converted to magnetic heading by applying the appropriate magnetic variation at the aircraft's present position. Magnetic heading is displayed on the PFD, ND, and DDRMI. There is no magnetic sensor in the system.

Note: When the aircraft is north of 73° north latitude and south of 60° south latitude, the IRUs only provide true heading on the PFD, ND, and DDRMI.

Inertial Reference Unit Alignment (continued)

Present Position Memory

Each IRU memorizes the computed present position when it is shutdown. If the entered coordinates for the next alignment differ from this value by more than approximately 60 NM, the CDU align light flashes after entry to alert the pilot to verify the coordinates.

Note: The present position memory is set to zero during IR maintenance and a flashing align light is a normal indication during the first alignment for that IR.

A second selection of the ALIGN IRS prompt will force the IRU to accept the alignment co-ordinates.

Quick Realignment

If previously aligned (i.e., during a through flight), the IRUs can be quickly realigned by turning all three MSUs to OFF, and back to NAV within 5 seconds. This allows for a 3 minute quick realignment after the IRUs have been previously aligned (for example, following a previous flight). The quick realignment is only possible if electrical power to the IRU has not been interrupted.

Note: All three MSUs must be selected to OFF before any MSU is reselected to NAV. This action prevents the insertion of incorrect alignment coordinates.

A five second countdown is provided on the CDU annunciator, with the message REALN DESN 5 SEC (realignment decision 5 seconds) displayed. The message counts down to zero seconds, after which a quick realignment is not possible.

Note: If the MSU is left in OFF for more than 5 seconds, a normal 10 minute alignment is initiated when the MSU is rotated to NAV.

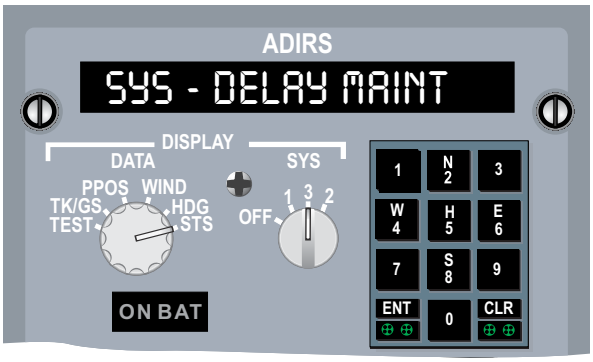
If the IRU determines that it has an excessive alignment error, a quick realignment is not possible and the IRU automatically initiates a normal 10 minute alignment. This would be indicated by the message IRS IN ALIGN > 7 MIN on the ECAM memo.

Quick realignments should normally be initiated at least 10 minutes before departure time to allow for a normal 10 minute alignment, if necessary.

Inertial Reference Unit Features

Messages

A number of ADIRU status messages can be displayed on the CDU annunciator. To display the messages for a specific ADIRU, the system display switch is rotated to the desired IRU, and the display data switch is rotated to status (STS). If more than one message is present, it automatically scrolls after a short delay. A complete list of the messages is published in the Vol 1, Supplemental section. An example is shown below for ADIRU 3:



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Note: The message STS-SWITCH ADR is normally displayed when the MSU is first moved out of OFF, and remains displayed until the ADR has completed its self test cycle.

Inertial Reference Unit Features (continued)

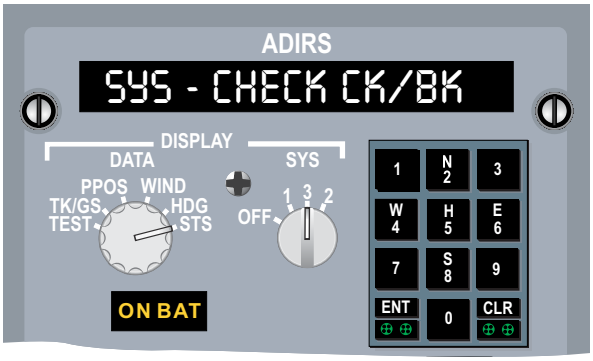
ADIRU Power

The ADIRU requires both AC and DC power to pass the initial self test. Once aligned, the ADIRU uses AC power primarily, with DC battery power as a backup.

A total loss of power to an ADIRU causes the IRU to lose its alignment. Present position is lost from that IRU for the remainder of the flight. If one or more ADIRUs lose AC power, the CDU amber ON BAT light illuminates. If this occurs on the ground, the external warning horn sounds.

Note: This is the same warning horn as the APU fire warning.

The IRU(s) that have lost AC power will display a STS - CHECK CK/BK (status - check circuit breaker) CDU message:



3/04 F340091C

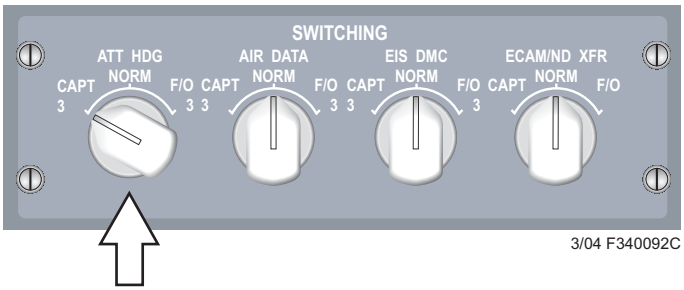
The ON BAT light illuminates for 5 seconds when initially rotating each MSU from OFF to NAV. This verifies that the IRU can operate on aircraft battery power. The ON BAT light does not illuminate when performing a quick alignment.

In the emergency electrical configuration, IRU 2 and 3 are automatically powered by the battery for 5 minutes. After 5 minutes, they are automatically unpowered. An exception to this case is discussed in the next paragraph.

Inertial Reference Unit Features (continued)

ADIRU Power Switching

Primary AC power for ADIRU 1 is normally supplied by the essential AC bus. This is the only ADIRU receiving AC power under emergency electrical conditions (refer to chapter 24, Electrical System). If ADIRU 1 has failed, emergency electrical AC power can be switched to ADIRU 3 by rotating the ECAM switching panel ATT HDG switch to CAPT 3.



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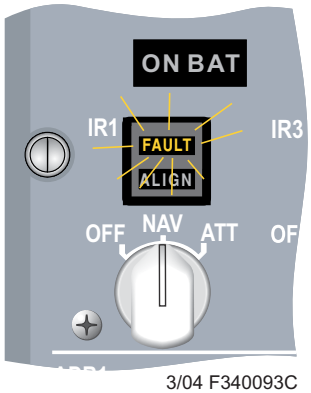
IRU Updates

It is only possible to update the IRU present position by performing an alignment with the aircraft parked. If a large error is discovered after alignment, a quick realignment can be accomplished with the aircraft parked. The correct coordinates are entered during the realignment.

IR Fault Light

If the FAULT light is illuminated steady, a total failure of the IRU has occurred.

If the FAULT light is flashing, a partial failure of the IRU has occurred. Present position from that IRU is lost for the remainder of the flight. Attitude and heading may be restored by performing an in flight alignment of the IRU (discussed next).



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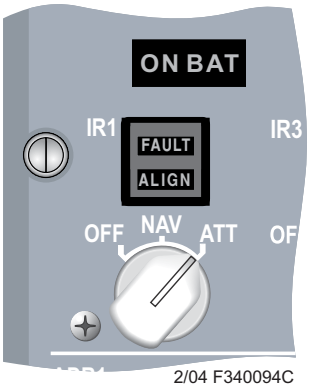
Inertial Reference Unit Features (continued)

In Flight Alignment

Attitude

A flashing FAULT light indicates that an in flight alignment may be performed and attitude information possibly recovered (refer to Vol 1, Supplemental Procedures). In flight alignments should always be accomplished when possible, to maximize IRU sources for the flight control computers and other systems.



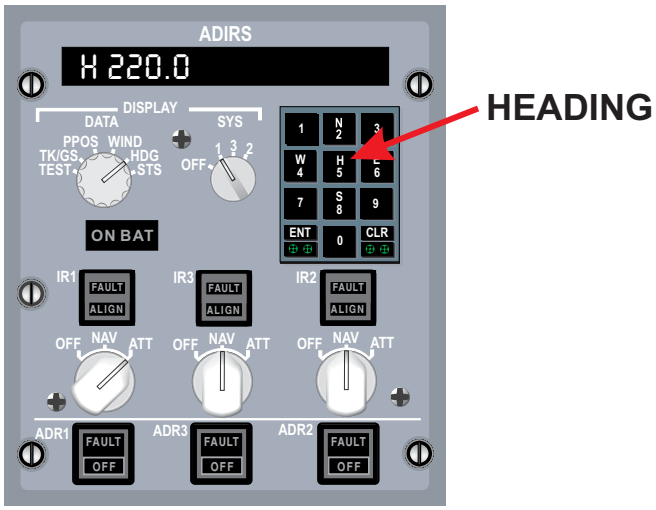
2/04 F340094C

Placing the MSU to ATT allows the IRU to determine the aircraft attitude. The MSU must be pulled out to move it from NAV to ATT. The aircraft attitude should remain straight and level with constant airspeed during the in flight alignment (approximate 30 seconds).

Heading Recovery

Heading can be recovered by entering the current aircraft magnetic heading on the CDU keyboard. Magnetic heading is entered by selecting the desired system (failed IR), rotating the display data switch to HDG, depressing the H key, and typing the magnetic heading. The ENT key enters the heading (refer to Vol 1, Supplemental Procedures).

True heading (from a functioning IRU) is displayed with the display data switch in HDG. Therefore, the aircraft magnetic heading cannot be determined on the CDU. It can be determined from the PFD, ND, DDRMI, or standby compass. An example magnetic heading entry of 220 degrees for a failed IRU 1 is shown below:



3/04 F340095C

When heading is recovered using this method, the magnetic variation is not updated as the aircraft position changes. Therefore, the magnetic heading must be manually updated at frequent intervals (approximately every ten minutes).

Global Positioning System

General

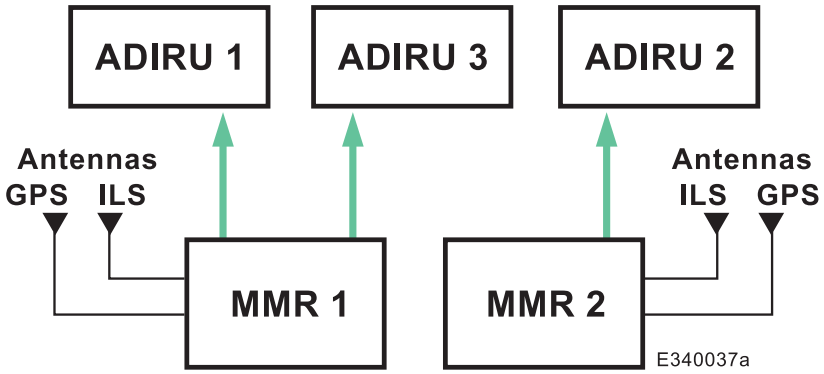
The Global Positioning System (GPS) is a satellite based radio navigation aid. A constellation of 31 satellites broadcast accurate navigation data that the aircraft's GPS receivers can use to determine position. GPS is highly accurate and is normally the primary means of position determination.

The aircraft has two GPS receivers. Each GPS receiver is integrated, along with the ILS receivers, in a modular avionics unit called the Multi Mode Receiver (MMR).

System Architecture

GPS may be installed with one of the following two system achitectures: Hybrid or Autonomous.

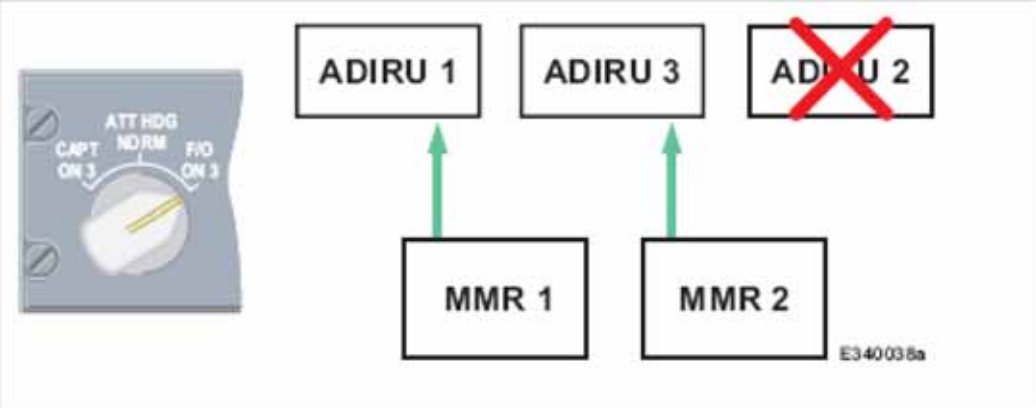
Hybrid Architecture: Each MMR processes the data received and transmits it to its associated ADIRU. The ADIRU then calculates a combined GPS-IRS position (the GPIRS position). The FMS uses the GPIRS position whenever GPS information is available. In normal operation, ADIRU 1 and 3 are supplied by MMR 1 and ADIRU 2 is supplied by MMR 2. (as shown below)



Autonomous Architecture: IRS and GPS positions are sent to FMS 1 and 2. IRS positions are corrected by a filter to determine the mixed best FMS position. Each FMS uses its associated GPS and calculates independently. There may thus be a slight difference between the two FMS positions.

Operation During Failure

If one MMR receiver fails, the remaining receiver automatically supplies all ADIRUs or FMSs



(Hybrid Architecture Depicted)

.Global Positioning System (continued)

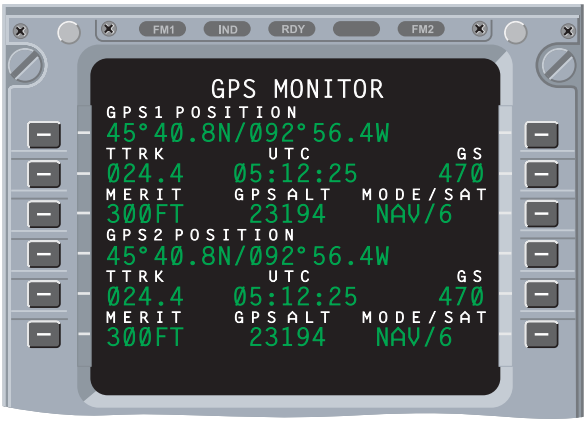
Theory of Operation

The 31GPS satellites orbit the earth in a predicable pattern stored in the GPS receivers. Each satellite contains a highly accurate atomic clock and constantly transmits a signal which includes the time it was transmitted. The two GPS receivers monitor the satellite signals and determine how long it took from the time each signal was transmitted until it was received, which yields the distance from each satellite. Position is automatically determined by triangulating the resulting distances. Time errors within the receiver's clock are corrected based on the satellites time signal.

When the receivers are able to track at least three satellites, a 2-dimensional position can be determined (lat/long). When four or more satellites are tracked, the aircraft's 3-dimensional position (lat/long plus altitude) can be determined. Groundspeed and track are determined by the rate and direction of position change.

GPS Monitor Page

Pure GPS position, true track, time (UTC), ground speed, accuracy level (figure of merit in feet), GPS altitude, operating mode, and the number of satellites currently tracked for each GPS receiver can be viewed on the GPS MONITOR page.



E340039a

Operating Modes

The GPS receivers can operate in four modes. The mode of operation is displayed on the GPS MONITOR page:

- INIT (Initialization Mode) - GPS hardware and software are initializing.
- ACQ (Acquisition Mode) - The GPS operates in this mode until it is able to track at least four satellites. It operates in this mode after initial power up and during long periods of lost satellite signal. In the acquisition mode the GPS does not provide a position to the ADIRS/FMGC. To aid in determining its initial position more quickly the GPS uses the initial position, time, and altitude from the IRS.
- NAV (Navigation Mode) - When the GPS can track at least four satellites, it enters the NAV mode and continually provides position data to the ADIRS/FMGC.

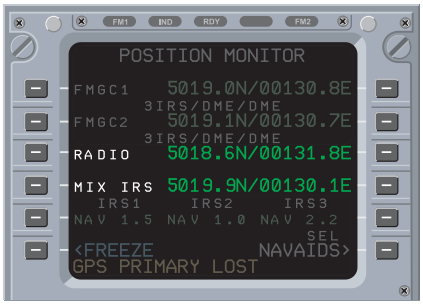
Global Positioning System (continued)

Operating Modes (continued)

- ALTAID (Altitude Aiding Mode) - Once in NAV mode, if the number of satellites tracked drops to three, the GPS uses the difference between last known GPS altitude and the IRS altitude at the time (altitude bias) to correct the current IRS altitude. If a fourth satellite has not been acquired within two minutes, the GPS reverts to acquisition mode.
- FAULT (Fault Mode) - A failure has been detected which prevents the GPS from passing on position data.

Indications

When both GPS accuracy and integrity (RAIM) requirements are met and the IRS is able to provide a GPIRS (hybrid) or GPS (autonomous) position, GPS PRIMARY is displayed on the PROG page. If GPS primary navigation is lost, the GPS field on the PROG page becomes blank, and GPS PRIMARY LOST is displayed on the ND and in the MCDU scratchpad. If GPS PRIMARY is regained, GPS PRIMARY is displayed on the ND and scratchpad.



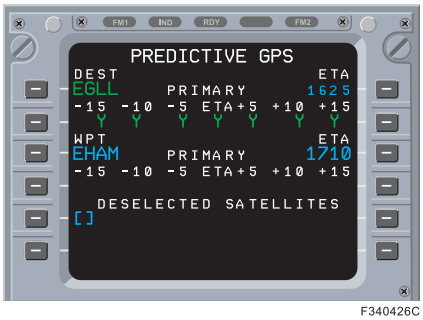
F340425C

RAIM (Receiver Autonomous Integrity Monitoring)

Internal functions of the FMS automatically monitor GPS signals for both accuracy and integrity. If the GPS confidence level requirements are not met, GPS PRIMARY LOST is displayed and a smooth transition occurs to navigation using DME/DME or VOR/DME radio position updates - if available. If radio updates are not available (e.g., out of range) NAV ACCURACY DOWNGRADE and IRS ONLY NAVIGATION messages will be displayed in the scratchpad if certain other conditions are met.

GPS Availability

Predictive RAIM is also provided. The availability of GPS signals can be predicted for a given place and time based on the predicted position of (and status of) the GPS satellites available. If RAIM is predicted as being unavailable at the destination ETA, GPS PRIMARY LOST is displayed.



F340426C

Global Positioning System (continued)

GPS Availability (continued)

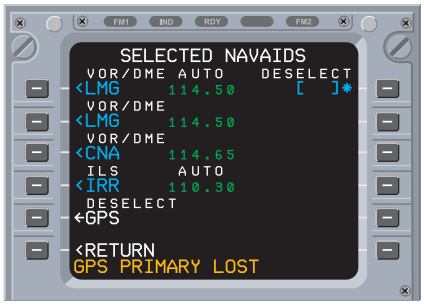
The PREDICTIVE GPS page, selectable from the PROG page, displays the predicted availability of GPS PRIMARY for 15 minutes before and after the given ETA at the destination and one additional airport or waypoint.

The identifying numbers of individual satellites which are expected to be unreliable or inoperative at the ETA, can also be entered on this page for use in the prediction calculation. The entered satellites are considered inoperative for the purposes of calculating the prediction, but their use is not restricted in actual operation.

Note: If a GPS satellite is actually inoperative it is automatically removed from the position calculation.

GPS Deselection

GPS navigation can be deselected manually via the DESELECT GPS prompt on the SELECTED NAVAIDS page.



F340427C

When the DESELECT GPS prompt is selected:

- The prompt changes to SELECT GPS
- GPS is not considered for position determination
- GPS PRIMARY LOST is displayed.
- GPS IS DESELECTED is displayed if within 80 nm of T/D, or if FMS switches to APPR phase.

GPS can be reselected by selecting the SELECT GPS prompt.

Intentionally Left Blank

Flight Management

General

The Flight Management System (FMS) is functionally divided into two sections: flight guidance (refer to chapter 22, Autoflight) and flight management.

Flight management functions include:

- Navigation
- Performance predictions and optimization
- Flight planning
- Flight guidance computations
- Navigation information display

Pilot workload is reduced with a navigation and instrument procedures data base. The overall cost of the flight is minimized by utilizing a Delta determined cost index (CI), which includes the cost of fuel, crew costs, and other factors.

During preflight, the pilot inserts the route from origin to destination via the MCDU. This route includes SID procedures, airways, waypoints, STAR procedures, instrument approach procedures, and missed approach procedures from the data base.

A vertical profile and speed profile is also inserted.

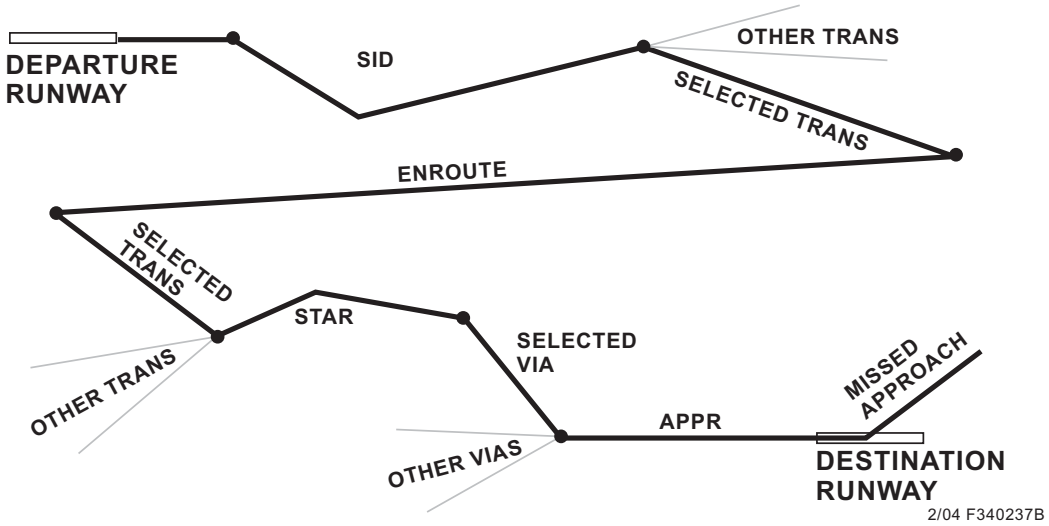
The FMS constantly computes the aircraft position. Utilizing the performance data base, it provides and manages all navigation data in order to guide the aircraft along the lateral and vertical flight plan. The speed profiles are optimized, with fuel use and overall cost minimized.

General (continued)

Flight Profile

After flight plan entry, the FMS computes the optimum flight profile from origin to the destination airport. The FMS provides flight guidance along the defined path while computing and displaying current and predicted progress along the flight plan.

To perform these functions, the FMS automatically tunes the navigation radios, determines the aircraft position, and computes the course along the entered flight plan. The FMS provides lateral en route guidance along defined procedures including SIDs, airways, STARs, holding patterns, and procedure turns. A lateral offset capability is provided, which allows the crew to parallel the active flight plan.



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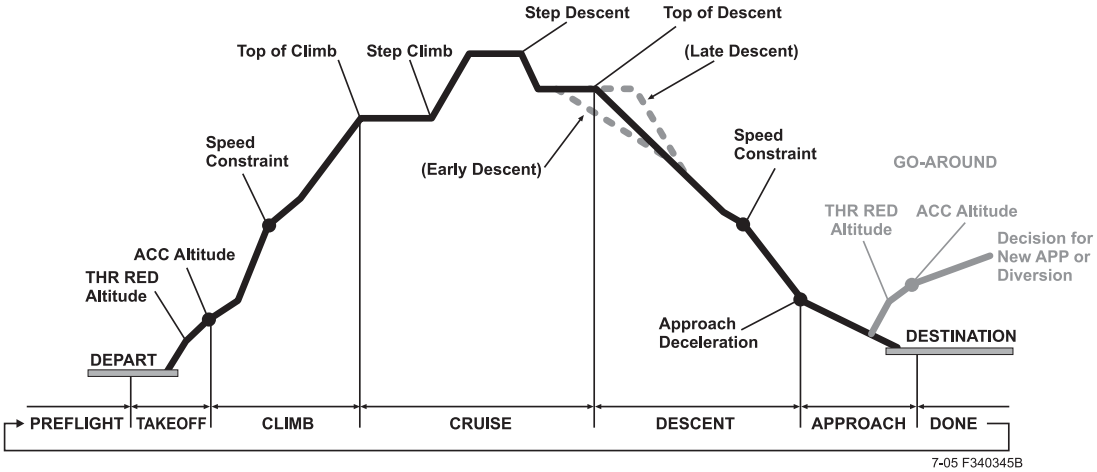
The system provides vertical guidance to a vertical path which honors defined altitudes and speeds. Vertical predictions include level off points, predicted top of climb and descent, and compliance with descent restrictions. In addition, predicted arrival times and fuel consumption along the flight path are continually updated.



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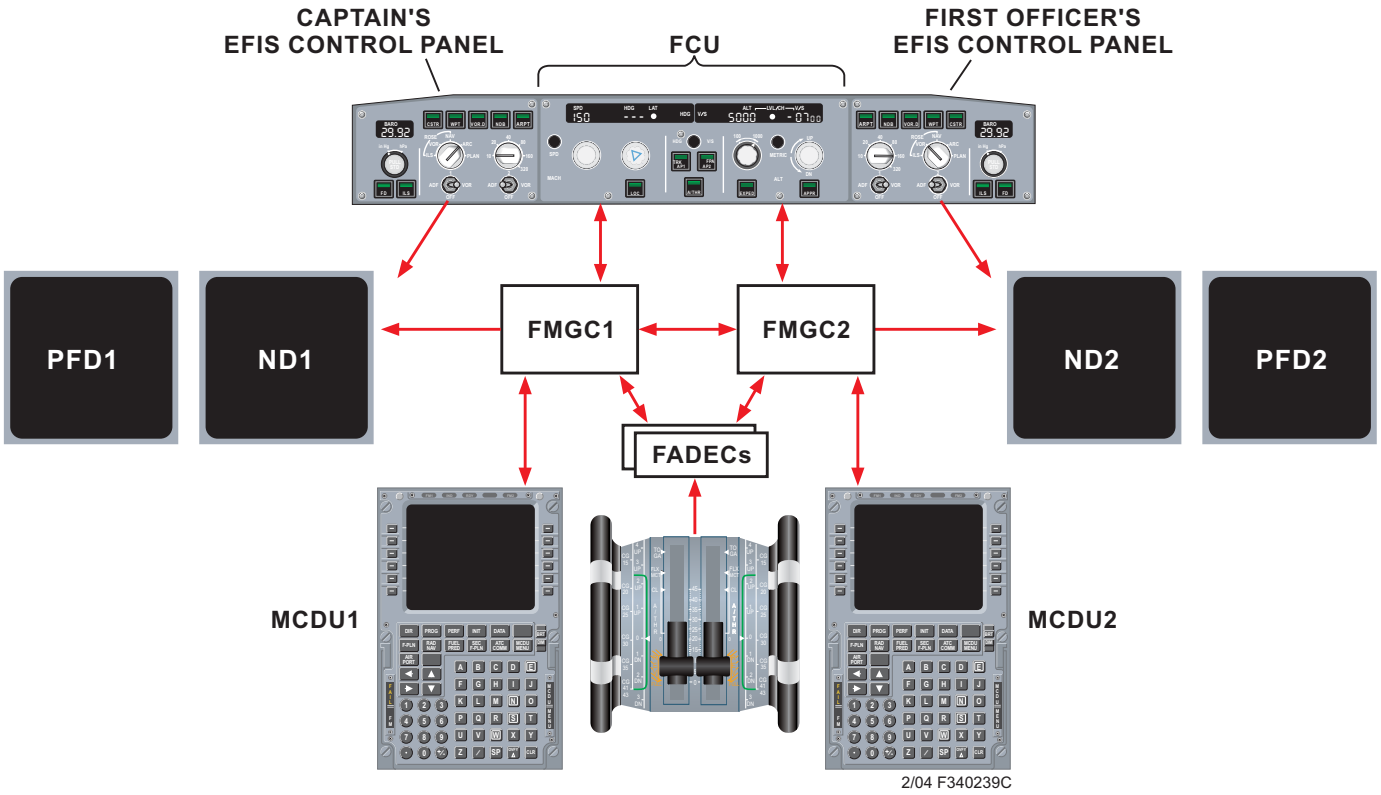
FMGC Operating Modes

General

The FMS is composed of two FMGCs and a number of other systems which provide the inputs to the FMS. The two FMGCs independently perform their own computations and navigation radio tuning. The FMGCs compare and exchange data through a cross talk bus.



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Operating Modes

There are three possible modes of FMGC operation:

- Dual
- Single
- Independent

The normal mode is the dual mode. The other degraded modes are automatically selected.

On-side FMGC

Each pilot's FMGC is defined as the “onside” FMGC for that pilot. FMGC 1 is defined as the captain's “onside” FMGC, and FMGC 2 is the first officer's “onside” FMGC. The opposite FMGC for each pilot is defined as the “offside” FMGC.

FMGC Operating Modes (continued)

Dual Mode

In the dual mode both FMGCs are synchronized. The FMGCs perform their own computations and exchange data through a cross talk bus.

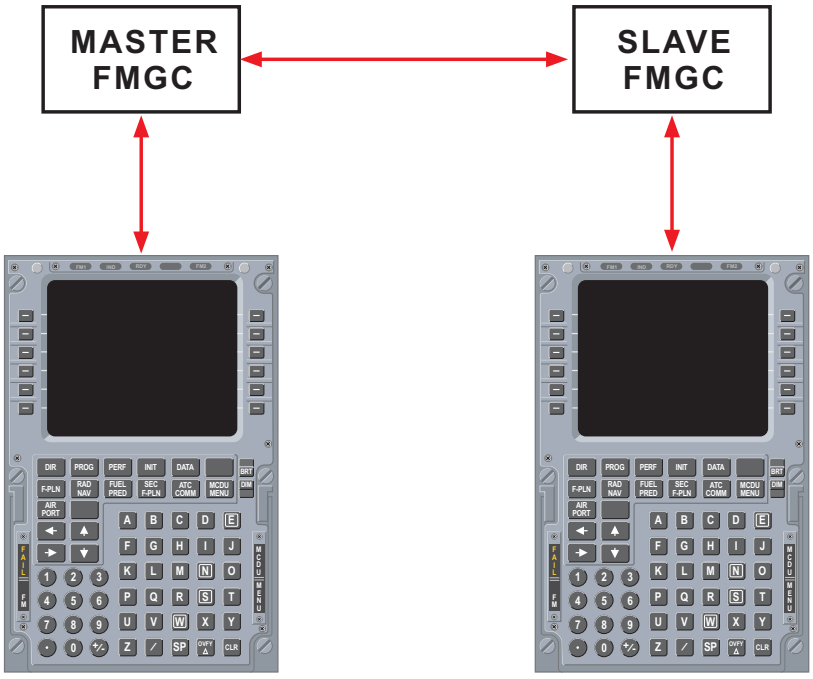
All data inserted via one MCDU is entered into the corresponding FMGC and transferred to the opposite FMGC and to other peripheral systems.

One FMGC is declared the master. The master FMGC computations are used for flight guidance, flight management, and Autothrust (A/THR) purposes. The master FMGC is determined by the following logic:

- If one autopilot is engaged, the related FMGC is the master (e.g., AP 2, FMGC 2)
- If two autopilots are engaged, then FMGC 1 is the master
- If no autopilot is engaged, then FMGC 1 is the master (assuming both flight directors are either ON or OFF together)
- If one FMGC is inoperative, the other is the master

Dual Mode Configuration

The FMGC dual mode configuration is shown below:



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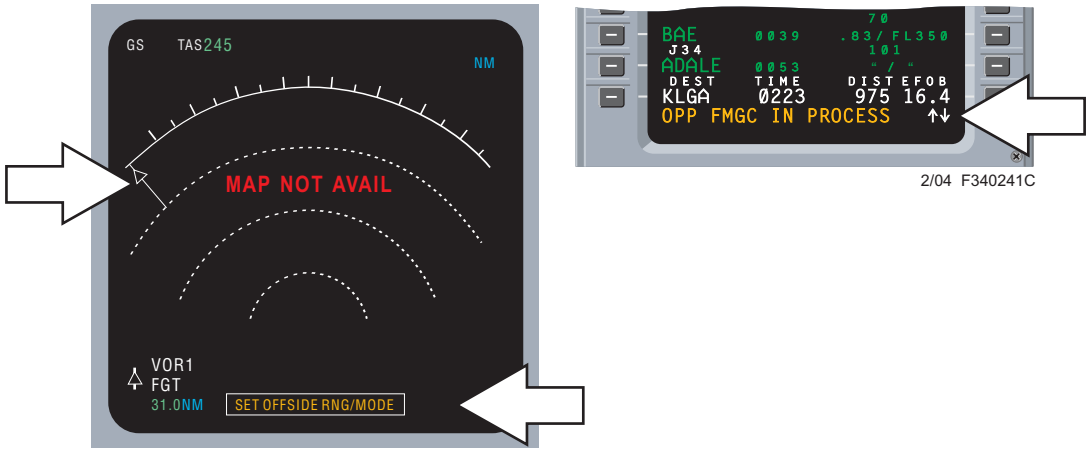
DUAL MODE

FMGC Operating Modes (continued)

Single Mode

The single mode is automatically selected following the failure of one FMGC. Although only one FMGC is operable, both MCDUs are functional. Either MCDU can be used in a normal manner.

The pilot can recognize that an FMGC failure has occurred by noting that the flight director information displayed on the PFD (e.g., if FMGC1 fails, 2FD2 is automatically displayed on the both FMAs). In addition, the following ND and MCDU messages are displayed:



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Note: An FMGC “failure” is different than an FMGC “reset” which is discussed later in this chapter.

The operating FMGC can generate only one display at a time. This ND mode and range is determined by the EFIS controls on the side of the operating FMGC. The ND message requests the pilot with the inoperative FMGC to match the EFIS display configuration of the opposite (e.g., SET OFFSIDE RANGE MODE) ND.

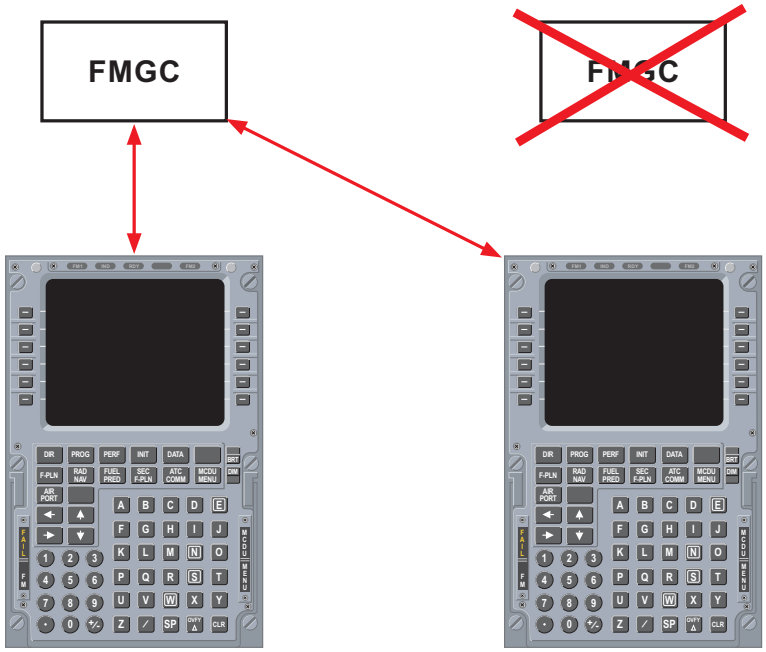
Note: In certain circumstances, one FMGC may have a transient failure and the single mode is triggered momentarily. During the resynchronization process, a MCDU PLEASE WAIT message is displayed on both MCDUs. The MCDU should not be used with this message displayed. The FMGCs do not respond to MCDU entries during resynchronization.

Note: In some cases, an ND message SET OFFSIDE RNG/MODE is displayed after the FMGC resynchronizes, and a MAP NOT AVAILABLE message replaces the map. With an operable FMGC, these messages may be cleared by cycling the EFIS ND mode.(e.g. ROSE, ARC, or PLAN).

FMGC Operating Modes (continued)

Single Mode Configuration

The FMGC single mode configuration is shown below:



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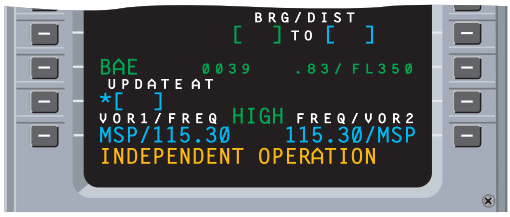
SINGLE MODE

FMGC Operating Modes (continued)

Independent Mode

The independent mode is caused by a significant mismatch between the FMGCs. Both FMGCs operate independently and are linked only to their own peripherals. The pilot can recognize independent operation by the following MCDU message:



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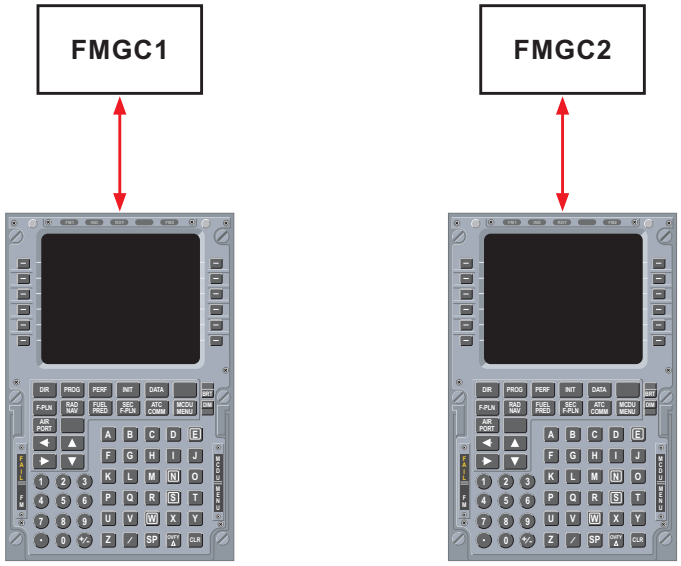
Any entry on one MCDU is transmitted to the associated FMGC only and affects onside displays only. For example, the flight plan must be entered on both MCDUs separately as no crosstalk occurs.

The FMGC position, data base, and gross weights can be compared to possibly determine the incorrect FMGC. However, other conditions not easily determined may cause independent operation.

Changing autopilots while operating in the independent mode may result in an aircraft flight path or airspeed change, as each FMGC may have a different flight plan.

Independent Mode Configuration

The FMGC independent mode configuration is shown below:



2/04 F340244C

INDEPENDENT MODE

FMGC Operating Modes (continued)

FMGC Monitoring

The FMGCs constantly compare computations. Significant differences between the FMGCs result in the following MCDU messages:

- FMS1/FMS2 GW DIFF (computed gross weight difference)
- FMS1/FMS2 POS DIFF (computed position difference)
- FMS1/FMS2 SPD TGT DIFF (computed speed target difference)

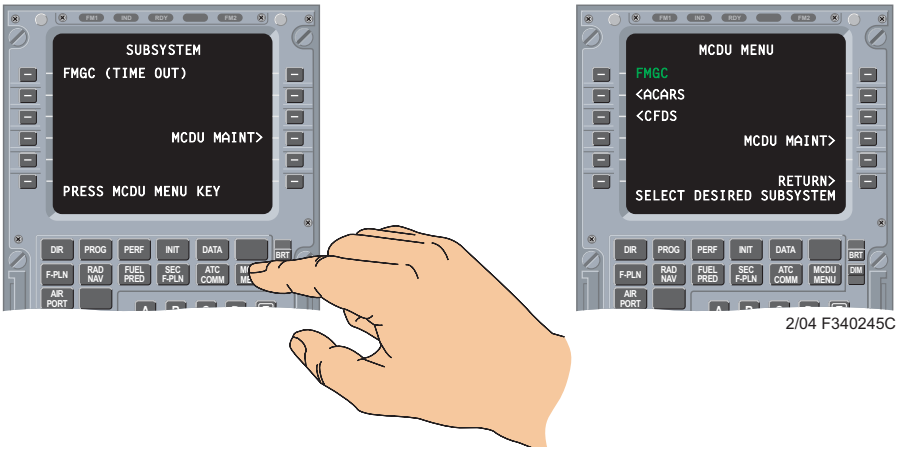
Note: Changing autopilots (i.e., changing the master FMGC) with one of the above conditions present results in corresponding changes in the aircraft flight path or speed.

FMGC Resets

An FMGC may “time-out” for periods of up to several minutes. An FMGC is not functional during the time-out, and the remaining FMGC operates in the single mode.

If the FMGC does not automatically resynchronize after a time-out, it may be restored by:

- Depressing the MCDU MENU key when the MCDU PRESS MCDU MENU KEY message is displayed, and then
- Selecting the FMGC system after a SELECT DESIRED SYSTEM MCDU message appears. If this message does not appear, or the FMGC does not reset after selecting the FMGC prompt, it may be possible to restore the FMGC by performing a reset using the FMGC circuit breaker (refer to the COM, Supplemental Procedures).



Note: After an automatic FMGC reset has occured the MCDU MENU page will appear with no MCDU annunciated light illuminated (as illustrated above right).

MCDU Failure

In the event one MCDU fails, both FMGCs can be accessed through the remaining MCDU. The pilot can recognize that the MCDU has failed, and not the FMGC, by noting that both flight directors are annunciated normally on the Flight Mode Annunciator (FMA). A normal annunciation is 1FD2 on the captain's and first officer's PFD. In this case both autopilots, flight directors, and NDs function normally.

FMGC Database

Databases

The FMGCs each have the following database:

- Navigation database - Updated every 28 days and contains a wide range of standard navigation data including:
  - Navaids
  - Airports
  - Runways
  - Airways
  - Waypoints
  - Holding patterns
  - Departure, arrival, and approach procedures.
- Airline configuration database - Contains parameters that may be customized for an airline such as taxi fuel, performance correction factors, reserve policies, and ATSU AOC customization.
- Aircraft performance database - Contains performance information for the airframe and engine type and is used to make performance calculations.
- Magnetic variation database - Allows the FMGCs to perform navigation calculations and determine magnetic heading without the need for magnetic sensors.

Two complete navigation and performance databases are always loaded in the FMGC, each coded with an effective date range. Preflight procedures provide a means to check and select the current database.

Note: A scratchpad message CHECK DATA BASE CYCLE will appear if the selected database date does not match the date as sensed by the a/c clock.

Caution: *Switching databases will cause the active and secondary flight plans, as well as stored data, to be erased and should never be accomplished in flight.*

Database Crossload

If the database in the two FMGCs are not identical, the FMGCs cannot operate in the dual mode, and independent operation will result. This may be result of an FMGC replacement prior to flight.

Though not normally a crew function, it is possible to crossload the current database from one FMGC to the other. This may only be accomplished prior to engine start or after engine shutdown (during the preflight or done phases). Transitioning from the flight phases (e.g. by starting engines) while a crossload is in progress will abort the crossload.

Note: If required, the crossload function may be accessed via the SOFTWARE STATUS/XLOAD prompt on the A/C STATUS PAGE. At least 20 minutes should be allowed for the crossload to be completed.

FMGC Database (continued)

Pilot Entered Data

Additional elements can be manually added and stored in the database temporarily. The additional elements are limited as follows.

- 20 pilot stored waypoints
- 20 pilot store navaids
- 10 pilot stored runways
- 5 pilot stored routes

Note: Runways cannot be added to an airport that is already defined in the database.

If an attempt is made to store more than the maximum value allowed a white scratchpad message is display (e.g. ‘LIST OF 20 IN USE’).

Manually stored elements can be created and reviewed on the PILOT STORED WAYPOINTS (WPTS), NAVAIDS (NAVS), RUNWAYS (RWYS), and ROUTES (RTES) pages.

The A/C STATUS page displays the current number of stored waypoints. In this example four waypoints have been stored.

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A DELETE ALL prompt is provide to delete the stored elements

If any of the stored elements are currently in use (e.g. part of the primary or secondary flight plan) the in-use items will not be deleted when the DELETE ALL prompt is selected, and the message F. PLAN ELEMENT RETAINED is displayed in the scratchpad.

FMGC Navigation

General

The two FMGCs independently compute the aircraft position by computing a position using a combination of the three IR positions (MIX IRS position) and the radio navaids when available (radio position).

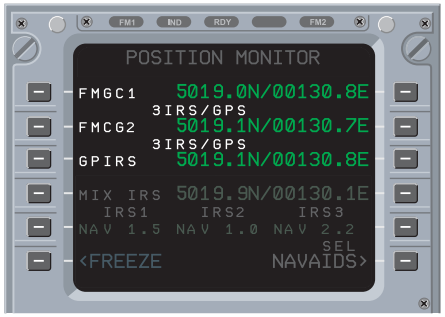
At least one IR position is required before the FMGC can compute an aircraft position.

GPS Equipped Aircraft Only

The two FMGCs independently compute the aircraft position for navigation by using a combination of the three IR positions (mix IRS position) and GPS position (or a radio position if GPS is not available). At least one IR position is required before either FMGC can compute an aircraft position.

The ADIRS supplies IR positions to each FMGC.

Hybrid Architecture: If GPS is available, the ADIRS also supplies an IRS based position fine tuned with GPS information (GPIRS). If GPS is not available, the FMGC will attempt to calculated a radio navigation position to improve the accuracy of the IR positions.



F340430C

Autonomous Architecture: IR and GPS positions are sent to the FMGCs. IRS positions are corrected by a Kalman filter to determine the best FMGC position (GPS). Each FMGC uses its associated GPS and calculates independently. There may thus be a slight difference between the two FMGC positions.

F340431C

During normal operations the GPIRS/GPS position is the primary position source. This state is referred to as GPS PRIMARY.

If the GPIRS/GPS data does not comply with integrity criteria, the GPS mode is automatically deselected and radio position updating (if available) is used. In this case, GPS PRIMARY LOST is displayed on the NDs and in the MCDU scratchpads.

FMGC Navigation (continued)

GPS Equipped Aircraft Only Cont.

For additional information on GPS position display and deselecting GPS, see Global Positioning System in the Radio Navigation and ADIRS section of this chapter, and the POSITION MONITOR, and GPS MONITOR page references in the MCDU Navigation section of this chapter.

To provide the best accuracy, the FMGC position is derived by using the navigation systems in the following order of priority:

All phases, except approach:

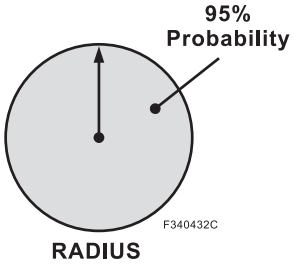
1. 3IRS/PGPS
2. 3IRS/DME/DME
3. 3IRS/VOR/DDME
4. 3IRS only

On approach:

1. 3IRS/GPS/LOC
2. 3IRS/GPS
3. 3IRS/DME/LOC
4. 3IRS/VOR/LOC
5. 3IRS/LOC

EPE (Estimated Position Error): The FMCG position is estimated with 95% probability to be within a circle of uncertainty.

The ESTIMATED circle radius is shown on the PROG page.



The system compares the ESTIMATED accuracy to the REQUIRED accuracy and then determines a HIGH/LOW accuracy level. Shown below:

F340433C

FMGC Navigation (continued)

GPS Equipped Aircraft Only Cont.

When GPS is not available: (lack of coverage or deselected) The FMGCs use the IRS and radio position as described below.

FMGC Radio Position

When airborne, each FMGC automatically tunes DME and VOR navaids to independently determine a radio position. Each FMGC may tune different navaids. The following priority is used in tuning navaids for navigation purposes:

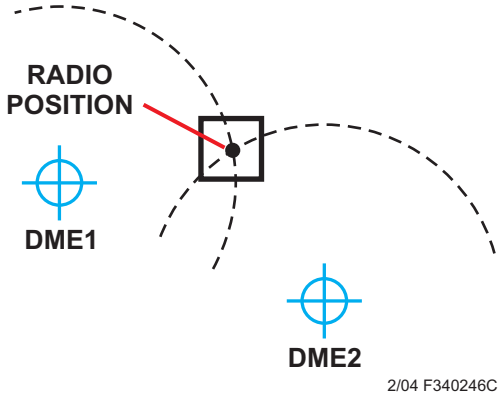
- DME/DME
- VOR/DME

During ILS and LOC approaches, the FMGCs also tune the localizer signal for an accurate crosstrack update (when in LOC* or LOC flight guidance modes only).

All navaids must pass a number of system checks, including identification and distance, prior to being used for navigation.

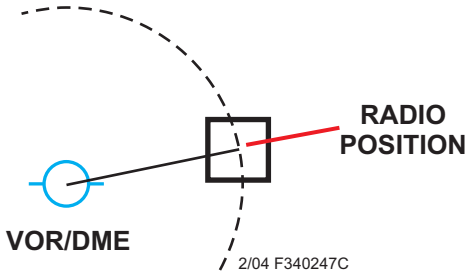
DME/DME

The primary method in determining a radio position is DME/DME. This method uses the intersection of two DME arcs to determine a position.



VOR/DME

If two DME signals are not available, the FMGC uses a VOR radial and DME to determine a radio position.



FMGC Navigation (continued)

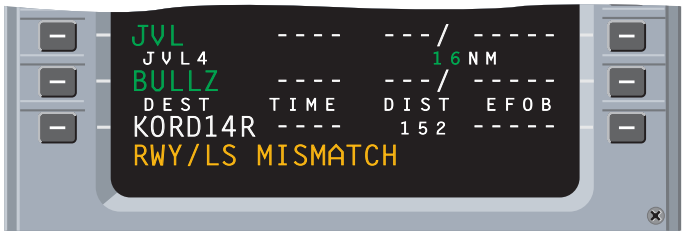
VOR/DME Receiver Failure

Each FMGC uses the associated VOR/DME for radio position (i.e., FMGC 1, VOR/DME 1). If that receiver fails, the FMGC automatically uses the radio position from the opposite FMGC.

ILS/DME

The FMGC uses LOC/DME to update the radio position during ILS or localizer approaches (when the LOC* or LOC modes are active).

If the ILS is manually tuned and the frequency associated with the destination runway does not match, the following message is displayed:



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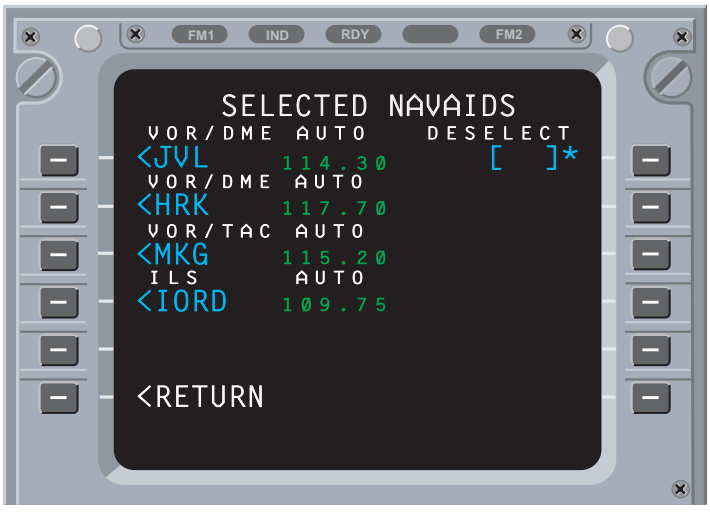
Selected Navaids

The pilot can monitor the navaids autotuned by the respective FMGC for navigation on the MCDU SELECTED NAVAIDS page, as shown below.



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The first navaid listed is the VOR/DME automatically tuned for display. The FMGC automatically tunes a VOR/DME for display. The pilot can manually tune this receiver, overriding the automatic feature.

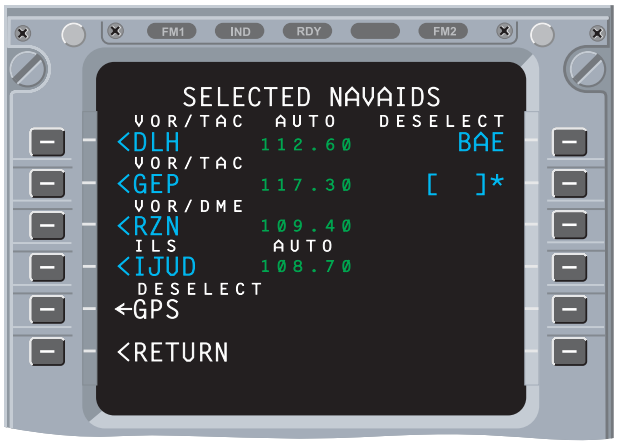
The second and third navaid listed are used by the FMGC in determining a radio navigation.

The fourth navaid listed is the selected ILS.

FMGC Navigation (continued)

Deselected Navaids

The pilot can deselect unreliable or NOTAMed navaids via the MCDU SELECTED NAVAIDS page. Up to six navaids can be deselected. In the example below, OBK has been deselected. This page also includes a DESELECT GPS prompt



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FMGC Navigation (continued)

Effect of VOR/DME Manual Tuning On FMGC Navigation

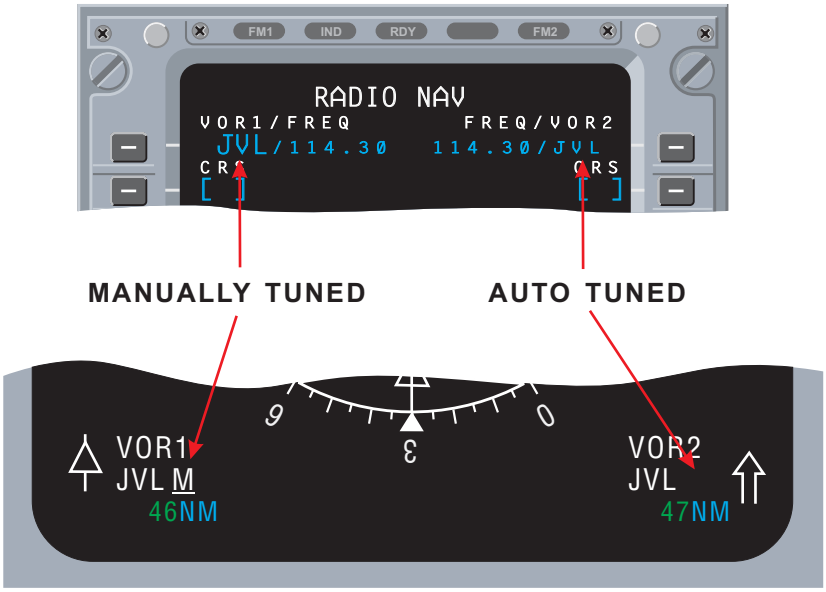
The pilot can manually tune a VOR/DME for display when desired. This does not affect FMGC DME/DME navigation due to multiple DME channels in each receiver. Each DME receiver is able to receive signals from up to five DME stations simultaneously.

If the FMGC is unable to accomplish DME/DME navigation, it uses VOR/DME to determine a radio position. In this case, a manually tuned VOR/DME may affect FMGC radio navigation by inhibiting autotuning.

For example, the pilot manually tuned the JVLVOR during departure to meet a SID requirement. The pilot forgot to clear the frequency. If the FMGC later attempts to navigate using VOR/DME and is out of range of JVL, an FMGC radio navigation position is not possible.

The pilot can recognize a manually tuned VOR/DME by:

- Large font on the MCDU RAD NAV page
- The letter M depicted in white next to the selected navaid data block on the ND.



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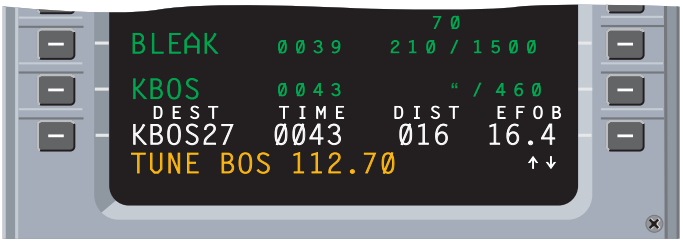
The MCDU message TUNE AAA XXX.XX indicates that the VOR required for position updating or approach cannot be autotuned because of manual VOR selection.



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FMGC Navigation (continued)

Displayed VOR/DME

When airborne, the FMGC automatically tunes a VOR/DME for display. VOR/DMEs which have been manually tuned by the pilot override this feature.

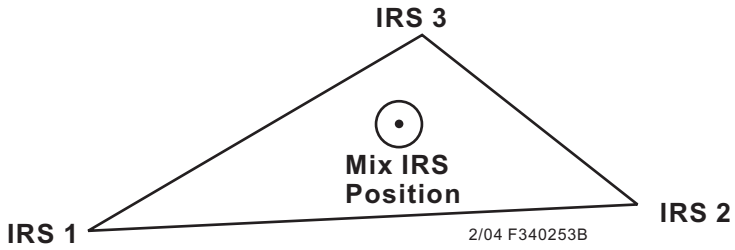
The VOR for display is selected using the following priority:

- The VOR required for a VOR approach
- The VOR required for position computation (e.g., VOR/DME navigation)
- The VOR corresponding to the active leg of the flight plan, as follows:
  - The TO waypoint (if a VOR)
  - The FROM waypoint (if a VOR)
  - The closest VOR.

Note: There is no requirement for the pilot to memorize this list.

Mix IRS Position

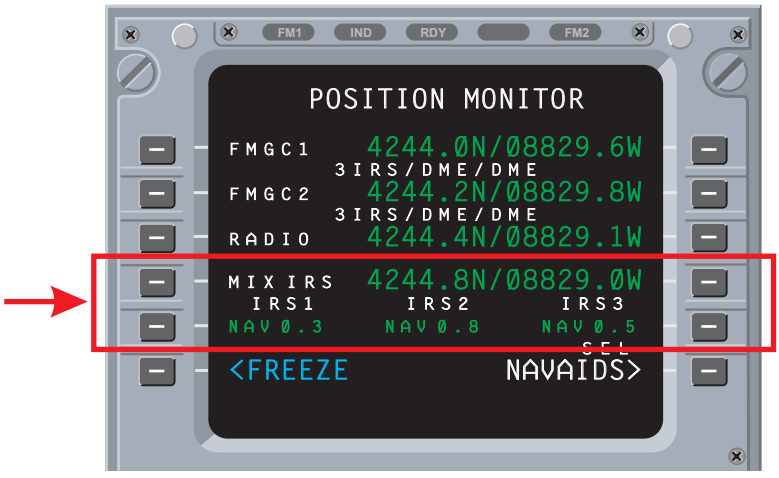
Each FMGC receives the three IRU positions and computes a position called the MIX IRS position. The FMS minimizes position errors from one IRU by "weighting" its position when different from the other two. The MIX IRS position is shown below:



If one IRU fails, a mix IRS position is not used. Each FMGC uses the associated IRU position (e.g., FMGC 2, IRU 2) as the mix IRS position. IRU 3 is automatically substituted for a failure of IRU 1 or 2.

Mix IRS Position Monitoring

The MIX IRS position, and the estimated IRS drift error of each IRU, can be monitored on the MCDU POSITION MONITOR page. The difference between each IRU and the onside FMGC position is displayed in nautical miles. An example is shown below:



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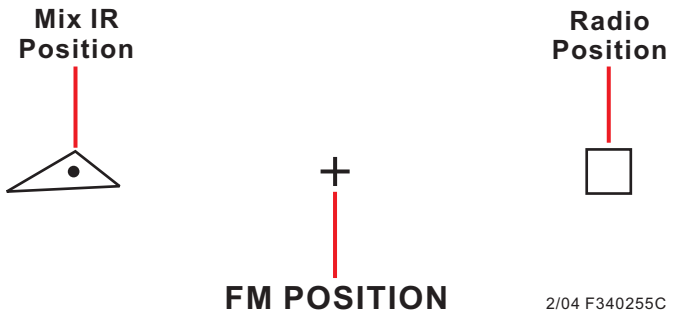
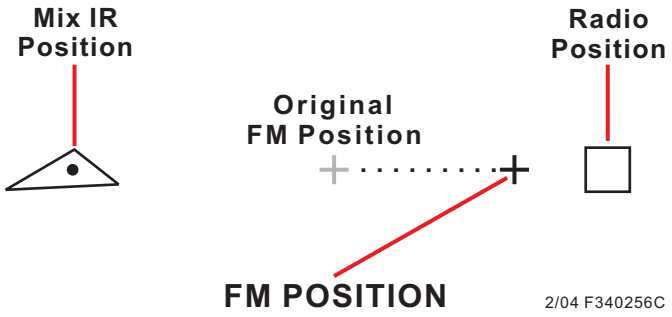
Flight Management Position

FM Position

Each FMGC independently computes a Flight Management (FM) position using the computed radio position and the MIX IRS position. These two positions are “weighted” by the FMGC to determine the FM position.

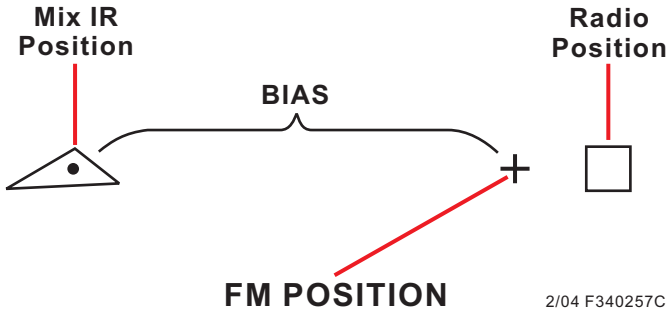


Over time, the FM position tends towards the radio position.



Bias

The FMGC memorizes the difference between the FM position and the Mix IRS position. This difference is called the “Bias.” The bias is constantly updated when airborne when a radio position is available.



If the radio position is lost in flight, the bias remains constant until a new radio position is achieved.

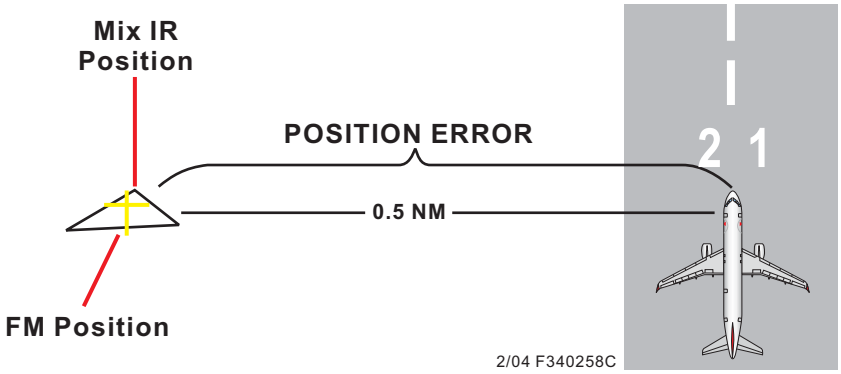
Note: A message NAV ACCURACY DOWNGRAD will appear on the MCDU sratchpad and on the ND when navigation accuracy downgrades from HIGH to LOW. When navigation accuracy upgrades to HIGH a message NAV ACCURACY UPGRAD appears.

Flight Management Position (continued)

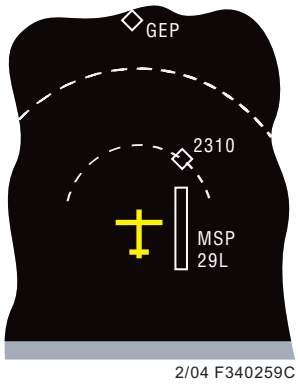
Before Takeoff (GPS PRIMARY not active)

Before takeoff, a radio position is not computed and the FM position is the same as the MIX IRS position. No bias is computed as the mix IRS position and FM position are the same.

This FM position reflects any error in IR alignment coordinate entry. In the example below, the aircraft is in the takeoff position for runway 21. However, the IR alignment coordinates were not slewed to the departure gate during the alignment (0.5 NM from the field reference coordinates). The difference between the field reference coordinates and the gate is reflected as a FM position error. The example below shows the error when the aircraft is in the takeoff position.



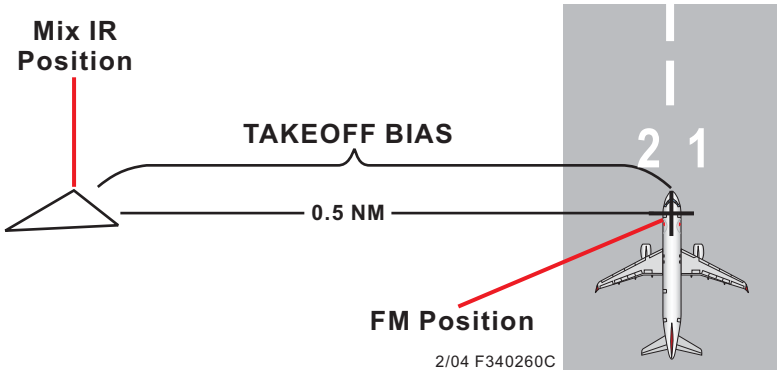
This error is also displayed on the ND as difference between the depicted runway and the aircraft position.



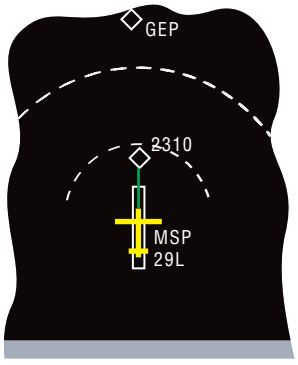
Flight Management Position (continued)

Takeoff Thrust Applied (GPS PRIMARY not active)

When the pilot applies takeoff thrust (TOGA or FLEX) the FMGC compares the data base position for the selected takeoff runway threshold and the MIX IRS position. This position difference is applied to the MIX IRS position to correct the FM position to the runway threshold. This position difference is called the “takeoff BIAS” and is stored in each FMGC memory.



The FM position and ND map are immediately corrected by the takeoff BIAS when takeoff thrust is applied. The pilot can notice a map shift if a significant bias exists. The runway is moved underneath the ND aircraft symbol when the takeoff bias occurs.

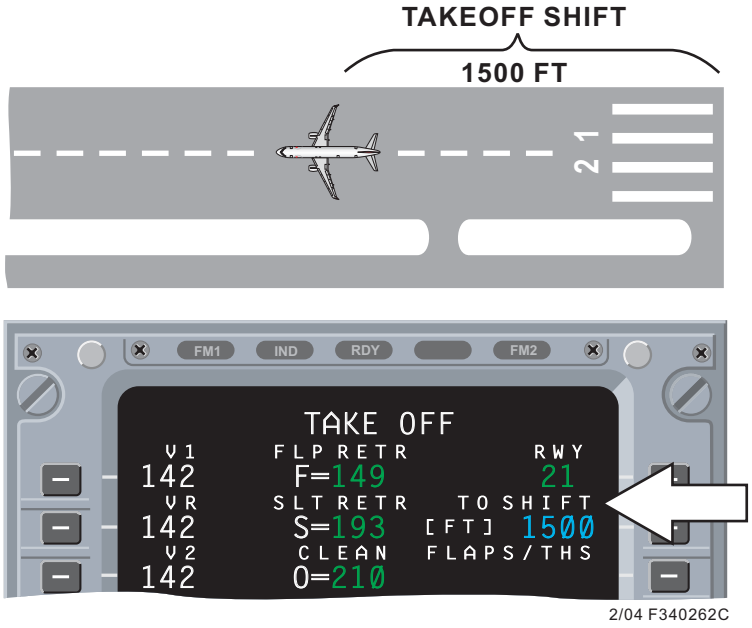


The FMGC does not compute a takeoff BIAS if a takeoff runway is not selected via the MCDU. If the wrong runway is entered into the flight plan, the takeoff BIAS is in error by the distance and direction between the runway thresholds.

Flight Management Position (continued)

Takeoff Thrust Applied (GPS PRIMARY not active) (continued)

The takeoff runway position can be corrected for intersection departures by entering a TO SHIFT via the MCDU (refer to MCDU operations).



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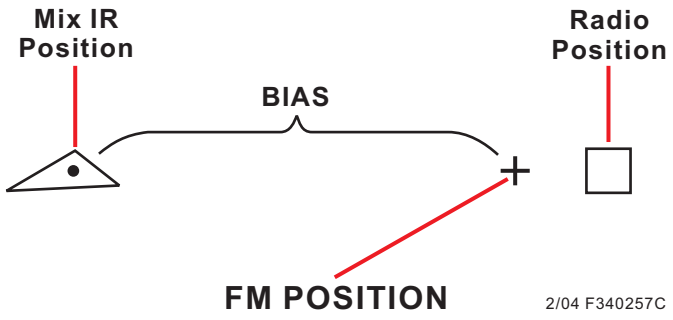
The takeoff shift entered is equal to the distance (in feet) from the runway threshold to the actual runway position at which takeoff thrust is applied. When this value is entered, the ND maps will shift according to the entered value.

Note: If **GPS PRIMARY** is active, the takeoff update does not occur and a takeoff shift need **not** be entered.

Airborne

When airborne, the FMGCs autotune navaids for navigation. The FM position is computed using the MIX IRS position and the RADIO position, and a new bias replaces the takeoff bias. This bias is updated at frequent intervals.



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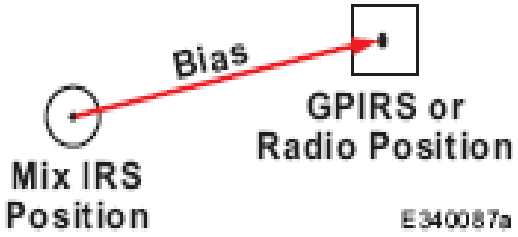
Flight Management Position (continued)

Loss of GPIRS/GPS and Radio Position

Each FMGC contionously computes a bias vector from the mix IRS position to the GPIRS/GPS or radio position. If the FMGC loses its GPIRS/GPS and radio position, it memorizes the current bias and uses it to compute the FMGC position, which equals the mix IRS position plus the bias. The bias remains the same until the GIRS/GPS or radio position is available. If the FMGC position is manually updated (available on the PROG page) the bias is also updated.



Note: When the GPSIRS/GPS or radio position is regained, the map on the ND will shift depending on the IR position versus the updated FMS position.

The pilot can recognize that radio position has been lost for a significant interval by the following MCDU message:

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Summary

The FMGC uses the best available information for computing the FM position. The following conclusions can be made:

Note: These do not apply to GPS equipped aircraft with GPS PRIMARY displayed.

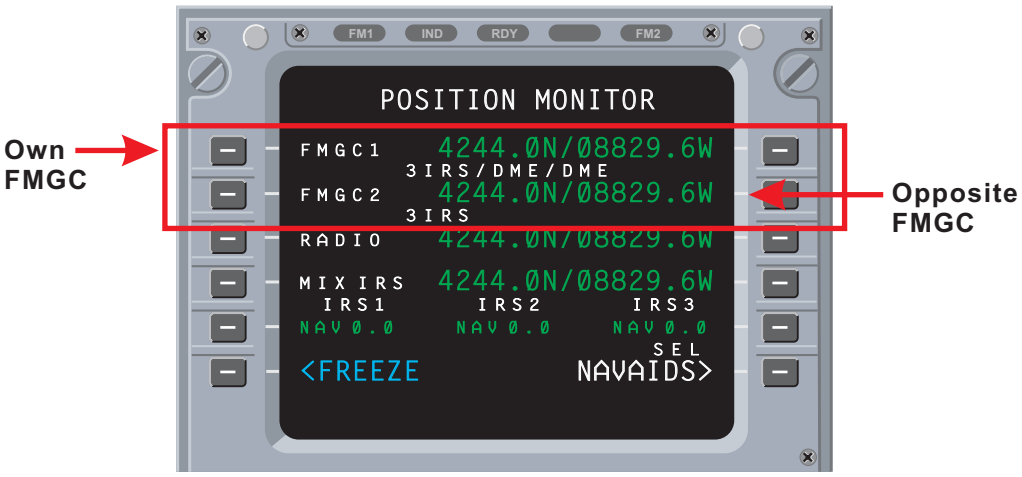
- Refining the IR alignment coordinates to the departure gate coordinates does not affect airborne FM navigation as long as a takeoff BIAS or a BIAS from a radio position is achieved when airborne. However, the alignment coordinates should be refined to the departure gate coordinates when possible to minimize IRU errors, especially at airports with limited radio navaids (e.g., Bermuda).
- An error or omission in selecting a takeoff runway does not affect long term FM navigation if a radio position is achieved after takeoff.

Flight Management Position (continued)

FM Position Monitoring

The pilot can determine the current means used to determine each FM position via the MCDU POSITION MONITOR page (refer to MCDU operations).

For example, in the example shown below, the onside FMGC 1 is using a MIX IRS position (using 3 IRs) with a radio position (using DME/DME). The offside FMGC 2 is a MIX IRS position only.



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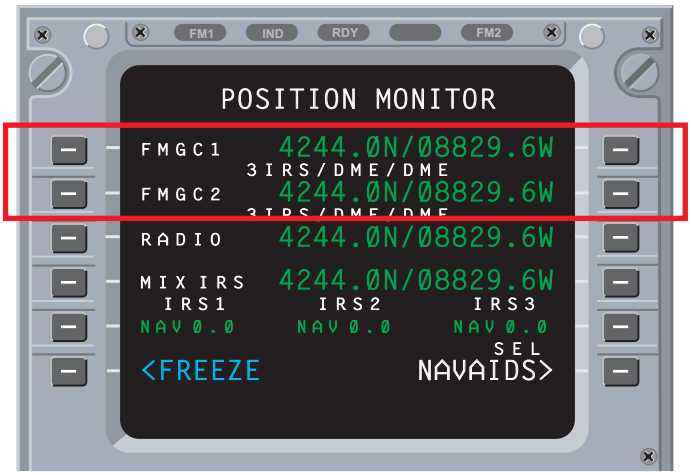
The FMGC positions may also be compared via the MCDU POSITION MONITOR page. The computed latitude and longitude of both FMGCs is displayed, as shown below:



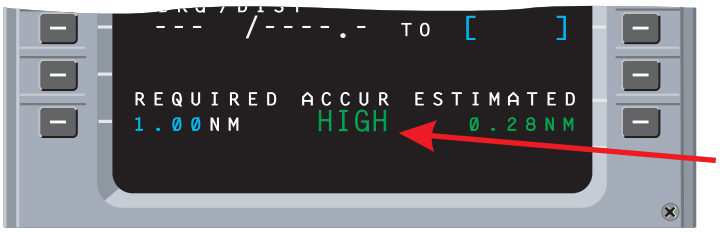
2/04 F340266C

The FREEZE prompt allows the pilot to freeze the positions for comparison.

Flight Management Position (continued)

Navigation Accuracy

The FMGC computes its navigation accuracy with respect to certification criteria. If the estimated navigation system accuracy meets those criteria, HIGH accuracy is displayed on the MCDU PROG page.



2/04 F340267C

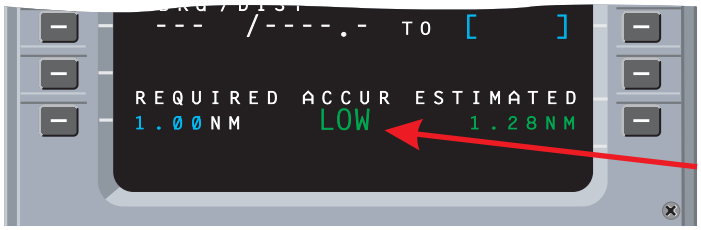
If the estimated position error exceeds those criteria, LOW accuracy is displayed. IRS only navigation does not necessarily result in LOW navigation accuracy. Low navigation accuracy is a result of large IR position errors, extended periods without a GPS or radio update, or other causes.

The accuracy criteria require lower errors for terminal and approach flight areas than during en route navigation.

Flight Management Position (continued)

Navigation Accuracy (continued)

When a change in navigation accuracy levels occurs, a corresponding message is displayed on the MCDU and ND. For example, the navigation accuracy will downgrade from HIGH to LOW when a radio position has been lost for a significant interval. When navigation accuracy downgrades from HIGH to LOW, an amber message NAV ACCURACY DOWNGRAD will be displayed both on the ND and the scratchpad.



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A corresponding white NAV ACCURACY UPGRAD message is displayed when the accuracy upgrades from LOW to HIGH.

When the radio position and MIX IRS position differ significantly, a MCDU CHECK A/C POSITION message is displayed.

Intentionally Left Blank

Performance Optimization

General

Introduction

Overall performance is enhanced by the FMS, which optimizes the:

- Speed profile
- Lateral profile
- Vertical profile

The entire flight profile is further modified by utilizing a Delta cost index (CI), which includes the cost of fuel, crew costs, and other factors determined by the airline.

The flight management calculations are only as accurate as the information available. For accurate computations, the pilot must correctly enter flight planning data including:

- Climb, en route, and descent winds
- Deviations from ISA standard atmospheric conditions (temperature at cruise FL and tropopause FL)
- Individual aircraft performance factor (PERF FACTOR)
- Arrival data (destination field QNH, temperature, and winds)

Note: The entry of deviations from standard atmospheric conditions only affects preflight predictions. Ambient conditions are sensed during the flight and aircraft performance predictions are automatically updated to compensate for the actual conditions.

If the pilot does not enter flight planning data, the FMS assumes the following:

- During preflight calculations:
  - A standard atmosphere
  - Normal aircraft performance
  - Zero winds
- During in flight calculations:
  - The winds currently calculated by the IRS are assumed to exist up to the next waypoint with a pilot entered wind
  - Zero winds and standard atmospheric conditions at the destination airport

The lack of accurate flight planning data may result in significant prediction errors, particularly on longer legs.

General (continued)

Cost Index

The cost index (CI) allows the airline to modify the entire flight profile. The cost index includes fixed costs (such as the aircraft leasing costs) and variable costs (fuel and crew costs). The cost index is entered by the crew during preflight and is normally not modified during flight.

The cost index can be varied to take into account differing costs on a particular segment. A CI of 0 results in a profile which uses the minimum amount of fuel. A CI of 150 or higher results in a minimum time profile. Managed speeds reflect changes in the CI:

- A decrease in CI decreases managed speeds
- An increase in CI increases managed speeds

Predictions

FMS predictions for the active and secondary flight plans (when displayed) are available on both the MCDU and ND.

MCDU Predictions

The predictions displayed on the MCDU assume that the aircraft is proceeding along the lateral and vertical flight plan. This results in the following:

- If the aircraft is on the flight plan routing (NAV mode engaged), the MCDU predictions correspond to the predicted values at each waypoint.
- If the aircraft is not on the flight plan routing (e.g., HDG mode engaged), the predictions assume an immediate return to the flight plan at a 45 degree intercept or direct to the TO waypoint (if more than 45 degree intercept is required). The flight plan must be manually updated to reflect the most current flight plan information for accurate predictions to be displayed.
- If the aircraft does not fly the managed speed profile (e.g., speed is selected), the predictions assume that the current speed/mach will remain active until the next speed constraint, speed limit, or FMS flight phase occurs.

ND Predictions

Predictions displayed on the ND will change depending on the engaged flight guidance mode.

The speed change symbol (magenta dot) is only displayed in managed speed, and indicates where the aircraft speed will automatically change.

Vertical pseudo waypoint symbols (e.g., leveloff arrows, T/D arrow, etc.) are displayed on the current aircraft track and indicate where the aircraft will reach the corresponding pseudo waypoint. If the vertical mode is changed, or the climb/descent is rate varied, these symbols will move to demonstrate where the aircraft will reach these altitudes.

Speed Profile

Speed Optimization

Optimum aircraft speeds are calculated throughout the flight, and are presented to the pilot as managed speeds. These speeds may be verified on the MCDU performance (PERF) page for the current and future FMS flight phases. Managed speeds are limited by speed limits, speed constraints, and configuration limits (refer to chapter 22, Autoflight).

Optimized speeds are summarized in the following table:

Flight Phase	Optimized Speed
TAKEOFF	SRS
CLIMB	SPEED LIMIT (defaulted to 250 kts below 10,000 MSL) ECON CLIMB SPD/MACH (above speed limit altitude)
CRUISE	ECON CRUISE SPD/MACH at the pilot entered cruise altitude
STEP CLIMB	ECON CRUISE SPD/MACH at step climb initial altitude
STEP CRUISE	ECON CRUISE SPD/MACH at step cruise altitude
STEP DESCENT	ECON CRUISE SPD/MACH at step cruise altitude
DESCENT	ECON DESCENT SPD/MACH (above speed limit altitude) SPEED LIMIT (defaulted to 250 kts below 10,000 MSL)
HOLDING	MAXIMUM ENDURANCE SPEED
APPROACH	Maneuvering Speed for the current aircraft configuration. Refer to chapter 22, Autoflight)
ENGINE OUT SPEEDS	Dependant on flight phase [see Engine Out Operations, this section.
GO-AROUND	GREEN DOT (except when holding)

Speed Profile (continued)

Holding Speeds

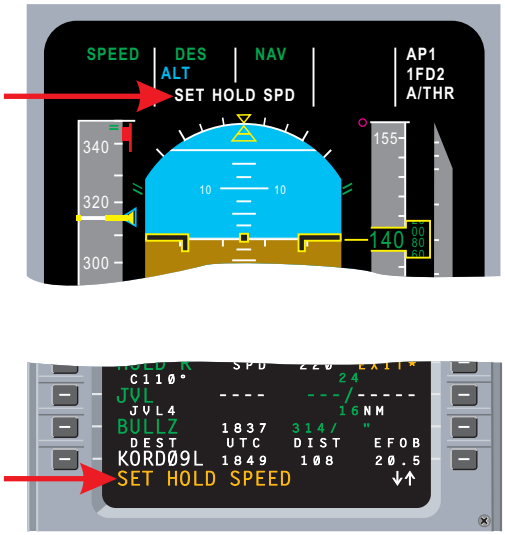
In all phases, the FMS computes a maximum endurance holding speed for the current aircraft altitude. This speed is the minimum of:

- Maximum endurance
- ICAO limits
- Flight plan speed limits and speed constraints

Caution: *When in the clean configuration, and at higher gross weights, the FMS may not prevent the aircraft from exceeding FAA holding speed limits below 14,000 feet MSL.*

The holding speed is predicted for the clean configuration (e.g., Green Dot) prior to the hold. It is calculated at the actual aircraft configuration when in the holding pattern, and is recomputed if the configuration is changed.

When managed speed is being used, a wind corrected deceleration point is computed, and a magenta dot is displayed on the ND flight path at the point at which the speed will automatically change. The aircraft will slow to cross the holding fix at holding speed. If the speed is selected, a PFD SET HOLD SPEED message is displayed just prior to the deceleration point.



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At the same time, you will get a message in the MCDU scratchpad that reads SET HOLD SPEED.

When holding in managed speed, the FMS will decelerate the aircraft to the holding speed. When exiting the hold, the aircraft will accelerate to the managed speed for the current FMS phase. For example, during the descent phase, this may cause the aircraft to decelerate from the econ descent speed (for example 290 knots) to the maximum endurance speed (for example 210 knots) when entering the hold. If still in managed speed when exiting the hold, the aircraft will accelerate to the econ descent speed (e.g., 290 knots) when exiting the hold.

Speed Profile (continued)

Engine Out Speeds

Optimum speeds following an engine failure are dependant on the phase of flight, as shown in the following table.

Speeds

Flight Phase	Optimized Speed
TAKEOFF AND GO-AROUND	SRS (refer to chapter 22, Autoflight)
CLIMB	Green dot (if climbing) or single engine Long Range Cruise (LRC) speed (if level)
CRUISE	Single engine LRC speed
DESCENT	Same as two engine speeds
APPROACH	Same as two engine speeds (V_{APP} can be modified for a FLAPS 3 landing via the MCDU APPR PERF page)

Speed Profile (continued)

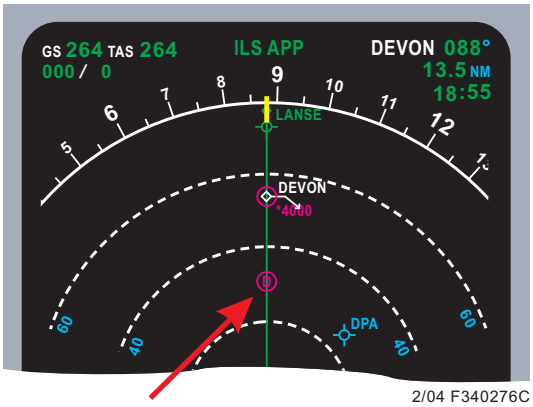
Decelerated Approach

The descent path is computed for a decelerated approach. A decelerated approach is computed for the ideal world (no ATC constraints) and for maximum fuel economy. It is planned for an idle descent, no speed brakes, and reaching “S” speed with FLAPS 1 when reaching the Final Approach Fix (FAF) or glide slope intercept point. A decelerated approach results in the aircraft being stabilized at V_{APP} no later than 1,000 feet AGL.

Note: This decelerated approach discussion is presented so that pilots can understand the assumptions used to determine the location of the decel point. This description of the FMS decelerated approach profile is not intended to replace SMAC procedures.

The decelerated approach begins at the decel point. The decel point is displayed on the ND as a magenta circled D symbol, as shown below.

If the aircraft passes over or near the decel point with NAV or LOC mode engaged and below a preset altitude, the FMS approach phase is automatically activated. Managed speed decelerates to green dot initially, and then S, F, and V_{APP} as the aircraft is configured.



DECEL POINT

Note: The FMS approach phase is not automatically activated by any other event, including the selection of flaps. Manual activation of the approach phase early does not affect the display of the decel point.

Note: If the NAV or LOC mode is not engaged, the pilot must manually activate the approach phase.

A decelerated approach assumes that the following profile is followed:

- The aircraft is on or below the computed descent path en route to the decel point.
- Speed is managed and the aircraft is configured to FLAPS 1 prior to intercepting the final descent.
- When below 2,000 feet AGL (1,500 feet AGL minimum), FLAPS 2 is selected. When F speed is reached, GEAR is selected DOWN, along with FLAPS 3. FLAPS FULL is then selected. The aircraft decelerates to V_{APP} and is stabilized in the landing configuration at 1,000 feet AGL.

Lateral Profile

Navigation Optimization

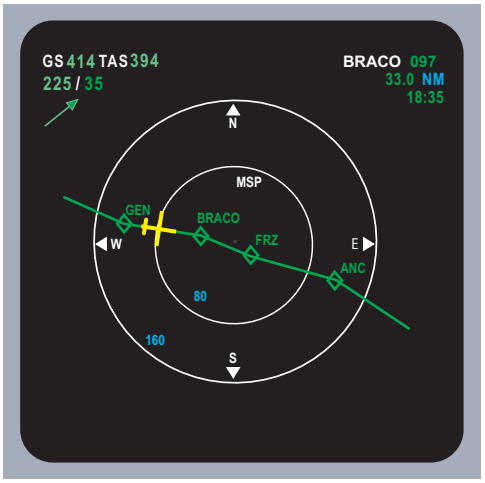
The lateral navigation profile is optimized by providing direct routing information, fuel and time predictions, and alternate routing displays.

Navigation predictions include Estimated Fuel On Board (EFOB) at the destination and Alternate (ALTN), and Estimated Time of Arrival (ETA). Predictions are not displayed until all required flight planning data (weight, flight plan, etc.) have been entered.

Lateral Profile (continued)

ND

Using the ND plan mode, the pilot can verify any portion of the flight plan at any time. Refer to MCDU Operations for a discussion of the required MCDU actions for each of the following examples. The active flight plan is depicted in green.



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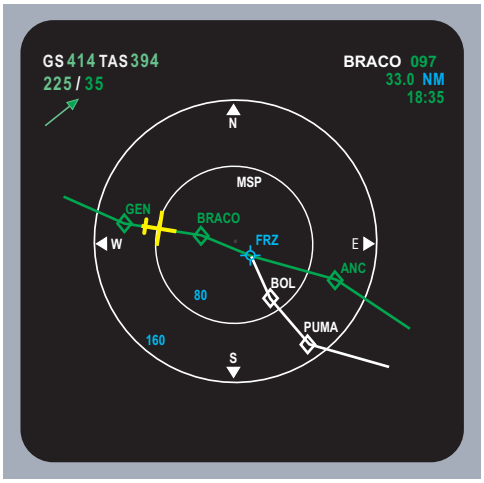
The secondary flight plan is depicted in white and can be displayed for comparison with the active flight plan. For example, the current routing (in green) can be compared with the original flight plan routing (in white).



2/04 F340278C

Temporary flight plans (TMPY) are depicted in yellow and are displayed prior to insertion to allow verification of routing.

2/04 F340279C

Lateral Profile (continued)

Navigation Assumptions

Navigation computations make a number of assumptions which affect the accuracy of displayed predictions when calculating ETA and EFOB. These assumptions include:

- Speed
- Routing
- Winds
- Cruise flight level
- Temperature

Speed

If speed is managed, then managed speeds are used for all predictions.

If the current speed mode is selected, that selected speed is used until the next FMS phase occurs. Subsequent phase predictions assume managed speeds. For example, if a speed is selected during the cruise phase, the predictions assume that speed will be held until the descent phase occurs.

Example: A slow speed selected for an ATC restriction early in the flight would result in a large change in ETA as the FMS assumes the entire cruise phase will be flown at that speed.

If a speed limit or a speed constraint is in the flight plan, predictions assume that speed to be the maximum speed until that point is passed during the climb phase. During the cruise or descent phase, FMS predictions assume that the current speed is held until reaching the speed limit or constraint, and then the limit/constraint speed is the maximum speed for the remainder of that FMS phase.

Routing

If the aircraft is on the active flight plan route, all predictions are based on the current routing. When changes are made to the flight plan, predictions are momentarily blanked until recomputed.

When vectored off the flight plan routing:

- MCDU predictions are based on a direct return to the flight plan.
- The flight plan must be manually updated to ensure logical predications are computed.
- ND vertical predictions are depicted along the current aircraft track.

Note: FMS predictions are based on the flight plan sequence as entered in the MCDU. If waypoints are not in a logical sequence, all predictions are computed based on the entered sequence. Large errors in predictions will occur unless the MCDU flight plan is kept current.

Lateral Profile (continued)

Navigation Assumptions (continued)

Winds

Predictions initially use pilot entered winds (at each waypoint) and climb winds (if entered). Wind predictions are corrected by IR sensed winds during flight, and are interpolated to the next entered wind. If winds are not entered at a given waypoint, the previous wind is propagated down downstream until a new wind is entered. Therefore, if the wind is constant during numerous legs, it must be entered in the flight plan only at the first waypoint.

Any error or omission in en route wind entry affects predictions, particularly during preflight. The failure to enter a 120 knot headwind, for example, would result in a large error in both ETA and EFOB, particularly during long segments.

A direct routing in flight deletes all wind information entered at intermediate waypoints.

A direct routing utilizing the abeam points feature will automatically transfer the winds as long as the original waypoint is less than 100NM from the abeam waypoint.

Cruise FL

The FMS uses the MCDU entered cruise FL for performance calculations (optimum cruise speed, fuel flow, etc.). Once the aircraft reaches the MCDU cruise FL, it is automatically updated during flight and follows the FCU altitude (refer to chapter 22, Autoflight: Soft Altitude Hold Mode). An inserted step climb or descent modifies the cruise FL for those segments affected. If an extended cruise at an initial altitude below the MCDU cruise altitude is anticipated, the MCDU cruise FL should be corrected to the FCU altitude.

Temperature at FL

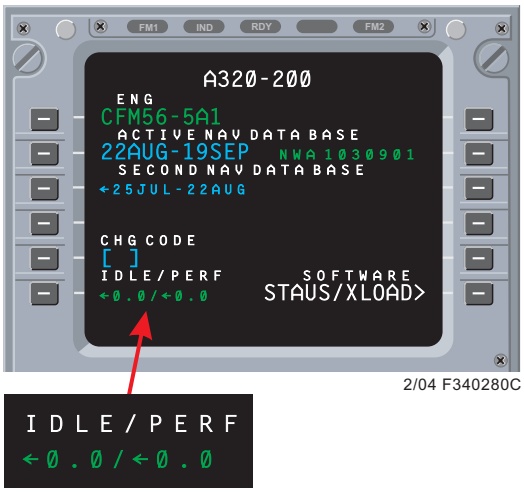
If the pilot enters the cruise FL and does not modify the temperature at that FL, the FMS assumes a standard atmosphere during preflight. When airborne, any deviation measured from standard conditions is applied to all subsequent calculations.

Performance Factor

The idle and performance factors, both set on the A/C STATUS page, effect FMS predictins.

The aircraft performance factor adjusts the calculation of aircraft fuel burn. The idle factor adjusts the assumed idle thrust for descents and will affect the descent profile.

For additional information on the effects of performance and idle factors see chapter 22, Autoflight.



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Vertical Profile

Vertical Optimization

The vertical profile is optimized by climbing at the optimum (ECON) speed, cruising at optimum altitudes, and descending in idle power at the optimum (ECON) speed.

Step climbs and descents at future waypoints can be evaluated, allowing for an early comparison of performance.

The descent profile minimizes fuel by crossing altitude constraints at the maximum altitude consistent with subsequent constraints, without an early leveloff.

Vertical predictions are based on the currently engaged vertical mode (CLB, OP CLB, V/S, EXP DES, etc.), and current aircraft performance (rate of climb/descent) adjusted by the aircraft performance data base.

Climb Predictions

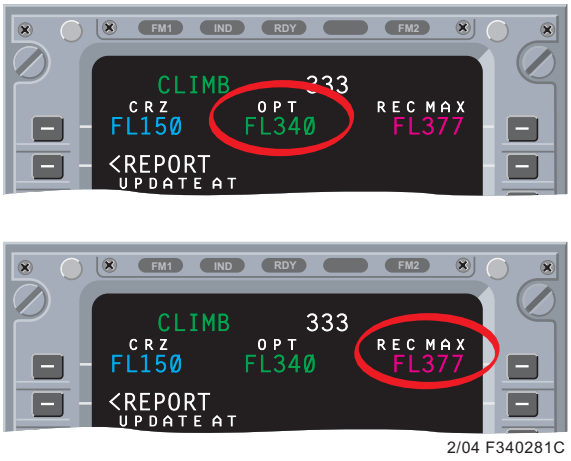
Predictions use the best available data. If the pilot does not enter climb winds, the Top of Climb (T/C) point calculation is based on winds currently sensed by the IRs. The T/C point takes into account flight plan vertical constraints.

Optimum and Recommended Maximum Altitudes

The FMS computes the Optimum Altitude (OPT) for the current atmospheric conditions, cost index, aircraft gross weight, and assumes a minimum of 15 minutes of cruise. A minimum of a 1.5G capability is provided at the optimum altitude

The recommended maximum (REC MAX) altitude provides a 1.3 G capability and a rate of climb of 300 ft./min at the current gross weight and atmospheric conditions.

Caution: *This value may display above FL391 which is Delta maximum certified altitude.*



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These altitudes are displayed on the MCDU PROG page and are not corrected for thrust degradations. These altitudes assume perfect aircraft performance. They vary during flight as the aircraft gross weight decreases and as temperature at altitude varies. For proper preflight performance calculations, the gross weight and temperature at cruise altitude should be entered via the MCDU.

Vertical Profile (continued)

Descent Profile Computation

The FMS computes the descent profile in an attempt to achieve the following objectives:

- Following the vertical (altitude and speed) flight plan elements
- The most economical path
- The most comfortable path

Vertical Flight Plan Elements

The vertical flight plan takes into account all available information including:

- Flight plan altitude constraints, speed constraints, and speed limits
- Specific segment restrictions such as instrument approach crossing restrictions, glide slope descent angles, etc.
- Aircraft decelerations associated with speed limits, and the configuration changes associated with a decelerated approach
- The effects of known winds, as entered by the pilot via the MCDU DES FORECAST and performance APPR pages
- Depressurization schedule requirements

The descent profile is computed from the runway backwards to the top of descent point when in the cruise phase. Once the descent has been initiated, the descent profile is computed from the runway backwards to the aircraft's current position.

The descent profile is recomputed whenever a change occurs in the flight plan or other data. For example, the profile is recomputed when the pilot selects a specific instrument approach or changes the destination weather data (winds, QNH, or temperature).

Pilot entered holding patterns are not included in the descent profile computations. Entry of a holding pattern in the flight plan does not cause the profile to be recomputed.

Economical Path

This is accomplished primarily by using the optimum speed profile (either econ speed or pilot entered auto speed) and idle thrust (plus a small thrust margin) whenever possible.

Comfortable Path

The FMS attempts to compute a profile which provides a comfortable descent. For example, low speeds at high altitudes are avoided.

Descent Profile

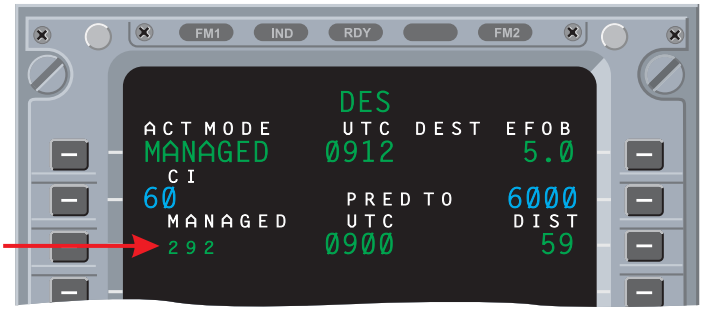
The descent profile is composed of the descent path and the approach path. The descent path begins at the top of the descent point (T/D) and ends at the decel point. The approach path starts at the decel point and ends at the runway threshold.

The descent profile is only updated if the flight plan is modified or approach data is entered (wind, altimeter, VAPP, landing flap data, etc.).

Vertical Profile (continued)

Descent Path

The descent path is computed using the econ speed for the descent phase, as displayed on the MCDU performance DES page. This speed is used for planning, regardless of the speed mode (selected or managed) that is currently engaged. The pilot can modify the FMS computed econ speed by entering an “Auto” speed on the MCDU performance DES. The AUTO speed is now used for computing the descent path.



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The pilot must enter descent winds before the FMS descent phase is active. If the pilot does not enter descent winds (via the MCDU DES WINDS page), the current winds measured by the IRs at the aircraft's altitude are used. These winds are interpolated to decrease in a linear manner relative to the wind entered at the destination via the MCDU performance APPR page.

An error or omission in entering descent winds affects the computed Top of Descent (T/D) point, and the computed descent path is in error.

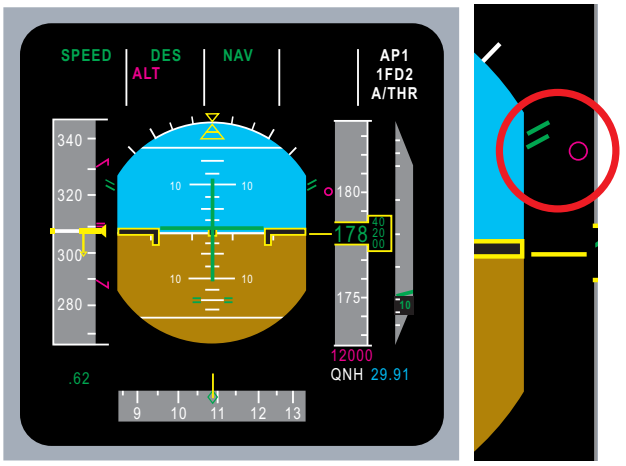
The FMS can maintain the descent path and compensate for lower tailwinds or higher headwinds than predicted by adding thrust during the descent. However, since the path is computed for idle thrust, only a limited capability exists for correcting for stronger than expected tailwinds, weaker than expected headwinds, or unplanned decelerations e.g., pilot or ATC initiated speed changes). This may result in the requirement for speed brakes, and in extreme cases the aircraft will be unable to meet speed or altitude constraints.

Descent path predictions ignore flight plan holding patterns, and assume that the hold is deleted prior to entering the holding pattern.

Vertical Profile (continued)

Descent Path Indicator

In the FMS descent and approach phases, the computed descent path is displayed on the PFD with the descent path indicator (“donut”).



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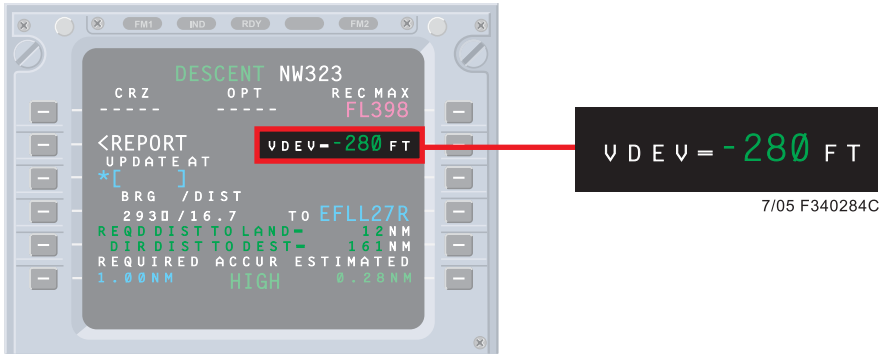
Descent Path Deviations

Deviations from the computed descent path are displayed on the MCDU as follows:

- When in managed DES mode, the aircraft's current deviation above (+) or below (-) the descent path is shown on the MCDU PROG page:



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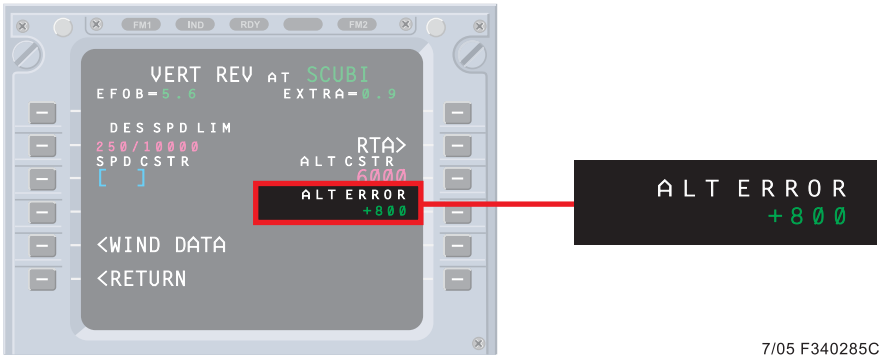
- The predicted speed or altitude error at a waypoint with an altitude or speed constraint is displayed on the MCDU F-PLN vertical revision page for the waypoint associated with the altitude constraint.



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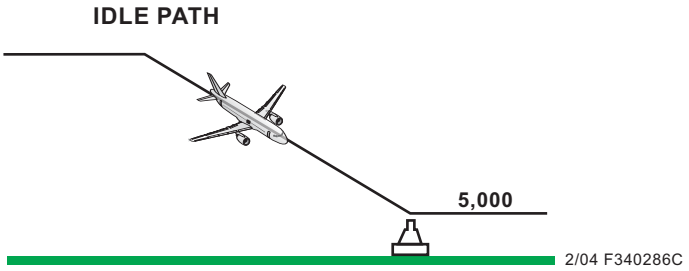
Vertical Profile (continued)

Descent Path Segments

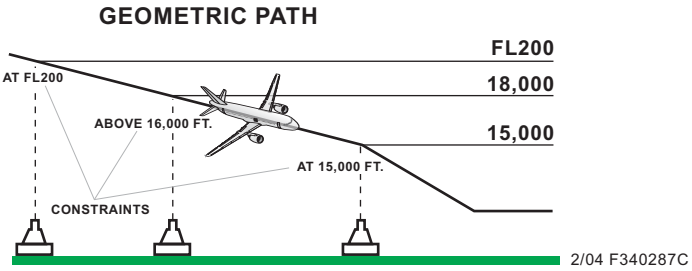
The descent path starts at the Top of Descent (T/D) point. Depending on the individual flight plan, the FMS may calculate three types of vertical path segments:

- Idle path - A segment where the AP/FD uses pitch to control the speed and the thrust stays slightly above idle. The path is computed from the top-of-descent (or end of the deceleration/repressurization path) to the first constraint that cannot be flown at idle thrust.



- Geometric path - A segment planned where the AP/FD controls the vertical path and autothrust controls the speed. Geometric paths are used from the first constraint that cannot be flown at idle to the DECEL point.

  Some geometric paths may require the pre-planned use of 1/2 speed brakes. No warning is provided to alert the pilot that the use of speed brakes is pre-planned for a specific segment; however, the descent path indicator would show the aircraft deviating above the descent path.



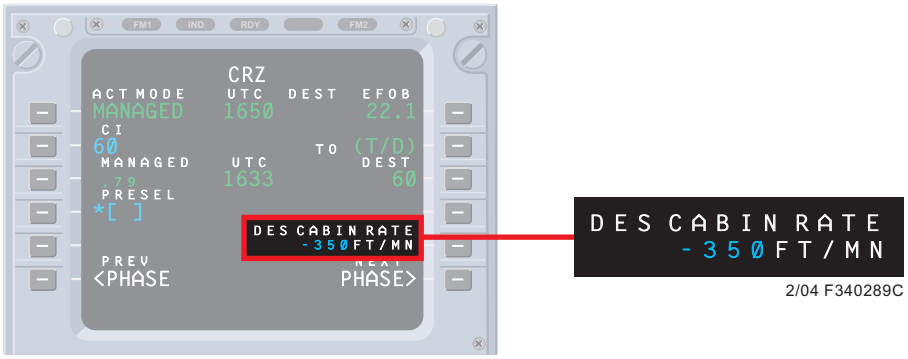
Idle path recomputation: For increased fuel economy, pilots can create an idle descent path where a geometric path exists. An Idle descent profile will be created from the present position to the frist downline constrained waypoint when any of the following actions are performed:

- DIR TO (any type) any waypoint
- ALT CSTR addition, change, or deletion on the active (geometric path) leg at the TO waypoint
- Change or reinsertion of SPD/ Mach on the performance DES page.
- Cost Index (CI) change or reinsertion.

Descent Path Segments (continued)

Repressurization path - A shallow segment used to begin repressurization of the aircraft to the destination airport elevation without exceeding the maximum cabin rate. The maximum cabin repressurization rate is defaulted to 350 ft./min and can be modified via the DES CABIN RATE field on the PERF cruise page

The effect of reducing the DES CABIN RATE is to move the T/D point to earlier in the flight. Increasing the repressurization rate would not usually affect the T/D point, as an idle path would be computed in this case.



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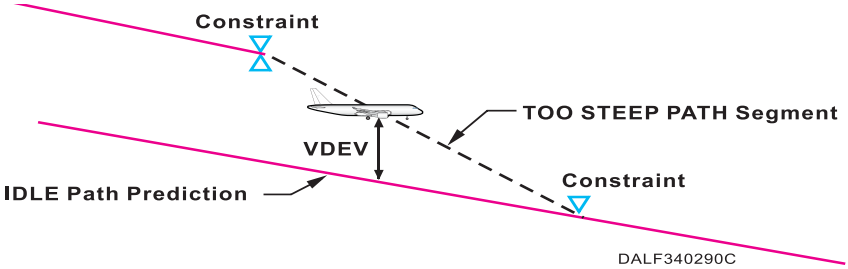
- When within 200 NM of the destination, if the FMS determines that the cabin cannot be repressurized without exceeding the maximum cabin rate, a CABIN RATE EXCEEDED message is displayed in the scratchpad.

Too Steep Path

If a segment of the descent path between two constraints is too steep to be flown at idle with 1/2 speedbrakes extended, a vertical discontinuity is created and the flight plan page displays TOO STEEP PATH. Predictions for way points between the constraints are not provided

When the aircraft reaches the beginning of the too-steep path segment, the descent path indicator and the MCDU VDEV value is recalculated using an idle segment to the next constraint waypoint. The VDEV value then displays the current deviation from the idle path.



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The TOO STEEP PATH AHEAD message is displayed in the scratchpad when the too-steep-path segment exists, and the aircraft is in cruise phase within 150 miles of the destination, or the descent or approach phases are active

- The VERT REV page for the way point at the beginning of the too-steep-path segment displays TOO STEEP PATH BEYOND in amber.

Vertical Profile (continued)

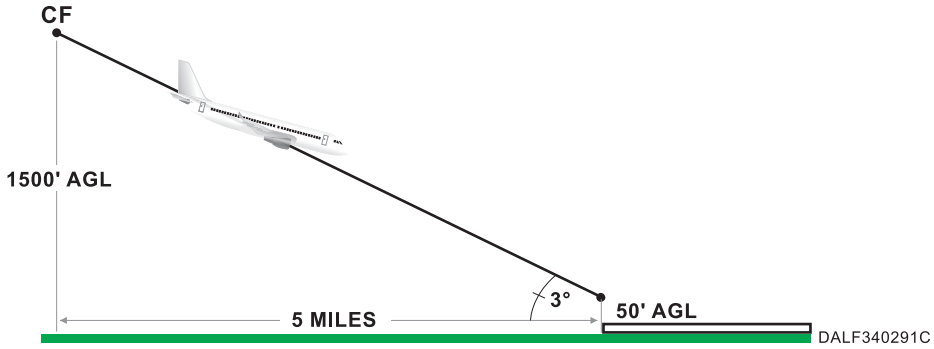
Approach Path

Before a runway is inserted into the flight plan the FMS uses some basic assumptions to calculate the required distance to configure, decelerate, and land. After a runway or an approach is inserted in the flight plan, the accuracy of predictions and vertical profile optimization is improved since it more accurately reflects what the actual descent profile will be.

The actual profile of the approach path varies with the configuration of the approach. The most common configurations are presented below.

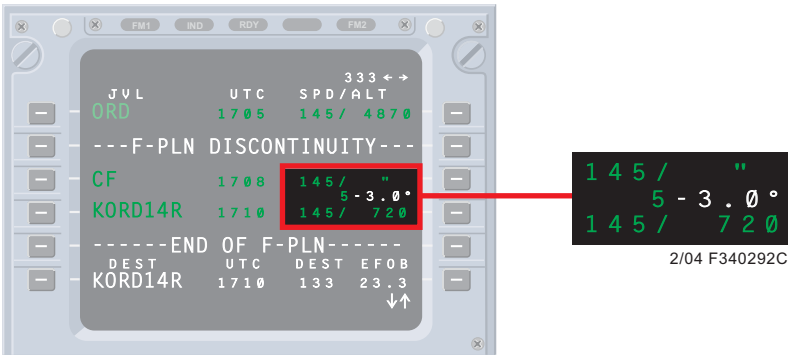
Runway Only Approach Path

If a runway is loaded into the flight plan without an approach, the vertical path is normally defined as a 3.0° descent angle starting at 1,500 feet AGL, and terminating at 50 feet above the destination runway threshold. This approach path starts at 5 NM from the runway and is displayed on the MCDU and ND as a CF (Course to a Fix) point after a VFR runway is entered in the flight plan. This descent angle is automatically modified if the data base includes a different descent angle for that runway.



The vertical approach path will be connected to any flight plan segments prior to the CF waypoint. This will automatically extend the vertical path prior to a CF waypoint.

The planned descent angle is displayed on the MCDU F-PLN page, as shown below:



Vertical Profile (continued)

Instrument Approach Path

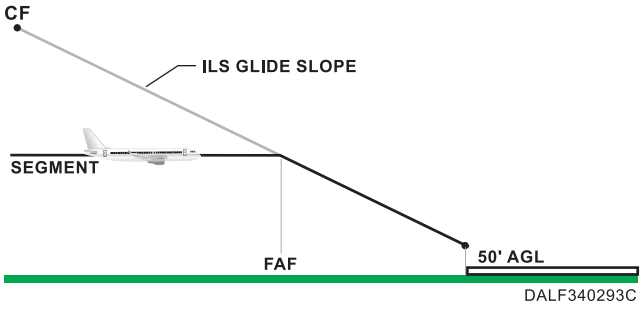
An instrument approach path is used whenever the pilot enters a specific data base instrument approach into the MCDU flight plan (e.g., an ILS, VOR, NDB etc., approach). Only data base approaches provide approach path calculations.

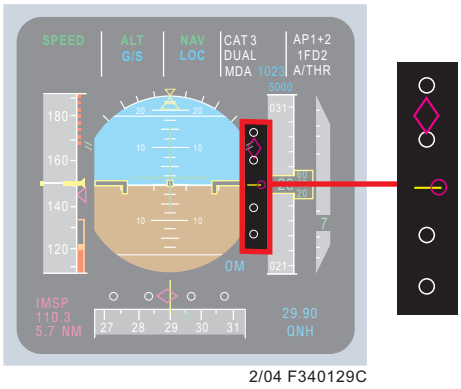
The approach path is computed to comply with the specified data base altitude restrictions on the approach. This may result in the approach path passing well above an “at or above” restriction.

Precision Approach Path

The specified glide slope for the approach is displayed on the MCDU flight plan page. It matches the ILS glide slope after the glide slope intercept point.

On many ILS approaches, the approach path is computed with a level deceleration segment prior to the glide slope intercept point. If the aircraft is on the approach path and prior to the glide slope intercept point, a level segment may result in the PFD glide slope indicator showing that the aircraft is well below the glide path. This indication may be confusing unless recognized.





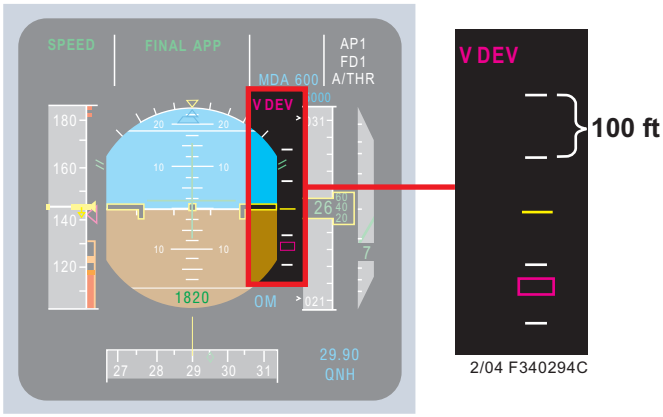
Aircraft on the vertical path, and below the glideslope

The descent path indication is removed from the PFD when the G/S* or G/S modes engage. If the G/S mode is lost, the descent path indicator is automatically redisplayed during the approach (until a go-around or landing is accomplished).

Vertical Profile (continued)

Non-Precision Approach Path

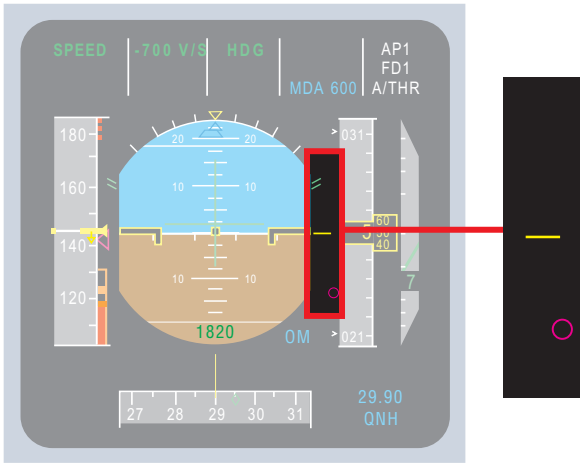
The approach path for non-precision approaches is displayed on the PFD with the Vertical Deviation (VDEV) indicator. The VDEV indication is displayed only on data base approaches when the FCU APPR pb is illuminated.



Each tic mark represents 100 feet vertical deviation. The VDEV indicator can be used in the same manner as an ILS glide slope indicator. However, unlike the G/S indicator, the VDEV indicator does not change sensitivity when approaching the runway. In the example above, the aircraft is approximately 150 feet above the approach path.

Note: The ILS glide slope deviation scale has priority over the VDEV indicator. If the EFIS ILS pb is illuminated, the VDEV indicator is not displayed on that pilots' PFD.

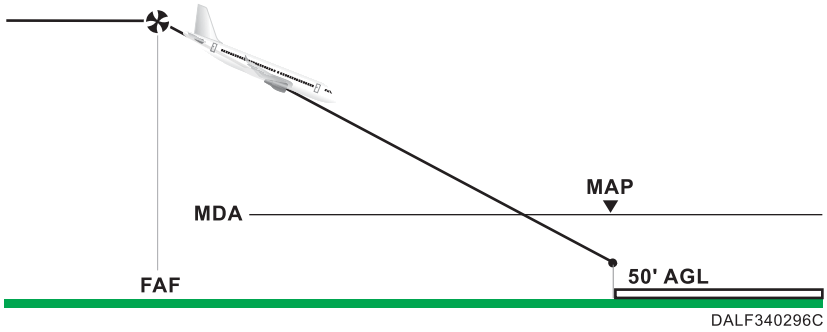
The VDEV indicator is automatically removed from the PFD when the aircraft reaches the Missed Approach Point (MAP) altitude, and is replaced with the vertical deviation indicator (donut).



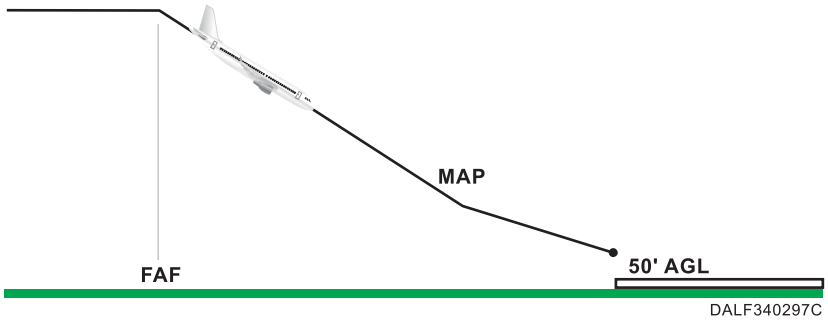
Vertical Profile (continued)

Non-Precision Approach Path (continued)

On a non-precision approach (VOR, NDB, etc.), the location of the Missed Approach Point (MAP) determines the design of the approach path. On most approaches the MAP is located just prior to or beyond the runway threshold. In these cases, the approach path is computed such that the aircraft reaches the Minimum Descent Altitude (MDA) while stabilized on the required descent angle. This angle is computed from the Final Approach Fix (FAF) altitude (or a stepdown fix altitude) to a point 50 feet above the runway threshold. This allows the aircraft to maintain the same descent angle from the FAF to the flare when using the FINAL vertical flight guidance mode (refer to chapter 22, Autoflight).



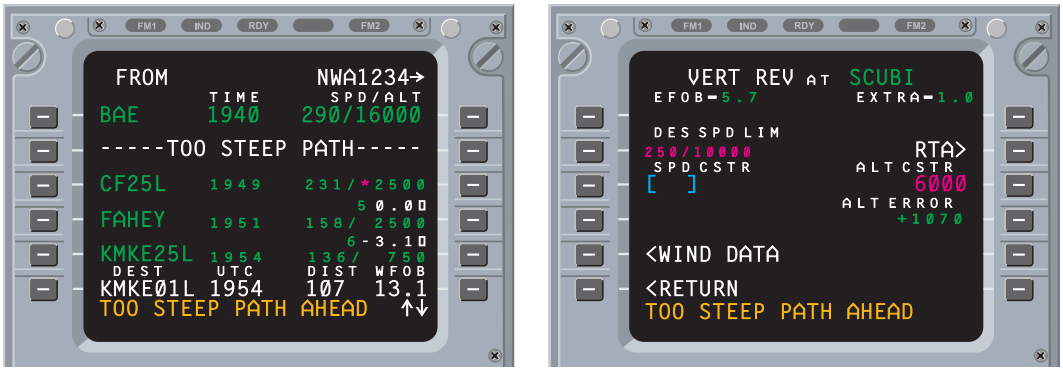
In the unusual case where the MAP is located well before the runway, the approach path is constructed from the FAF altitude (or a stepdown fix altitude) to the MDA at the MAP. This may require a change in the aircraft's descent angle when the aircraft reaches the MDA at the MAP when using the FINAL vertical flight guidance mode.



Vertical Profile (continued)

Too Steep Path

If a particular segment is predicted to be so steep that the aircraft cannot remain on the path without accelerating (at idle thrust and 1/2 air brakes), a MCDU TOO STEEP PATH message is displayed on the F-PLN page between the two corresponding waypoints. A vertical discontinuity is automatically entered into the flight plan at that waypoint, as shown on the F-PLN vertical revision (VERT REV) page. These messages are automatically removed when this condition no longer exists. In the example below, a vertical discontinuity exists after BAE.



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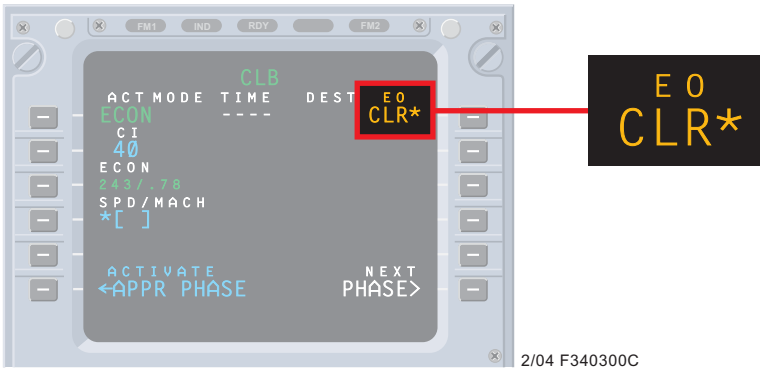
If the lateral NAV mode is engaged as the aircraft reaches a predetermined distance from the destination, and a too steep segment exists, a MCDU TOO STEEP PATH message is displayed.

Vertical Profile (continued)

Vertical Predictions Following An Engine Failure

Following an engine failure, if the aircraft is above the EO REC MAX altitude (displayed on the PROG page) all vertical path predictions are removed from the MCDU, PFD, and ND. The descent path indicator, VDEV display (PROG page), and managed descent (DES) function are not available. Once the aircraft descends below the EO REC MAX altitude (or if the engine successfully restarts), vertical predictions and the managed descent mode will again be available.

The pilot can restore all of the vertical predictions above the EO REC MAX altitude by depressing the MCDU EO CLR prompt on the MCDU PERF page. However, vertical predictions will then be based on two engine performance data in the database.



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ND Vertical Prediction Depictions

Introduction

Pseudo waypoints symbols are displayed on the ND to indicate where the aircraft will level off, continue a climb or descent, automatically decelerate or accelerate, etc. Symbols are provided to indicate waypoints with constraints, and to identify those constraints that will be met, missed, or ignored.

Pseudo waypoint symbols are not displayed on the ND for secondary flight plan predictions.

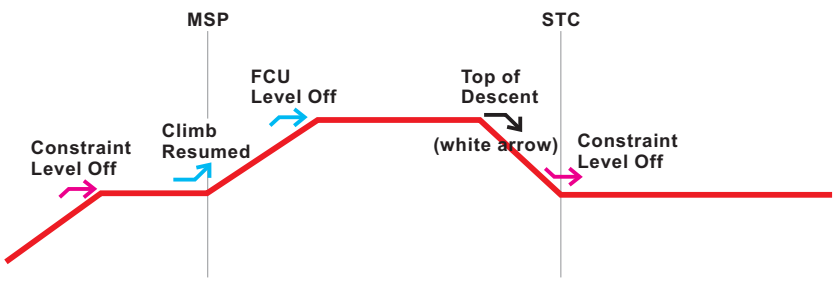
Climb, Descent and Level Off Arrows

Arrow indications depict the pseudo waypoints where changes in the vertical profile are predicted to occur. The arrows are depicted along the flight plan line while managed NAV is engaged, or along the track line if HDG or TRACK is engaged.

Arrows are utilized for display on the ND as follows:

- Blue arrows indicate the action will take place automatically.
  - Level offs at an FCU altitude
  - Continuation of climb or descent after a constraint level off (managed vertical engaged)
- Magenta arrows indicate the action will take place due to a constraint.
  - Climb or descent level offs due to a constraint, (if more restrictive).
- White arrows indicate the action is planned but the FMS cannot automatically accomplish it.
  - Start-of-climb when CLB is not engaged
  - Top-of-descent
  - Continuation of descent when DES is not engaged

The sample scenario below shows a series of climb, descent and level of arrows. A level off from a climb and descent are depicted as follows:



Profile view of example vertical path

ND Vertical Prediction Depictions (continued)

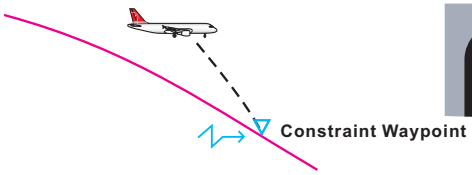
Descent Path Intercept Point

The intercept symbol indicates the point where the aircraft will intercept the computed descent path, and is only displayed when a significant deviation from the path occurs. The symbol is depicted:

- White if DES mode is not armed
- Blue if DES mode is armed or engaged. The DES mode is armed only when an automatic level off has occurred due to a constraint and a subsequent descent will automatically occur when the constraint waypoint is passed.

When the aircraft is above the path, the location of the descent path intercept symbol assumes that speed brakes are actually deployed to 1/2. In this condition, if the speed brakes are not deployed, the descent path intercept will move along the flight path indicating the point at which the aircraft will intercept the path if speed brakes are immediately deployed to 1/2.

When the descent path intercept symbol reaches the waypoint with the constraint, a PFD MORE DRAG message is displayed.



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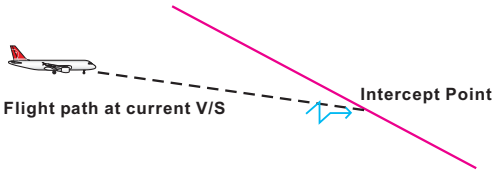
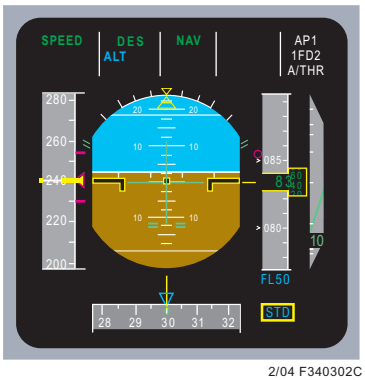
If the aircraft is below the path, the descent path intercept symbol is calculated for the actual speed brake configuration.





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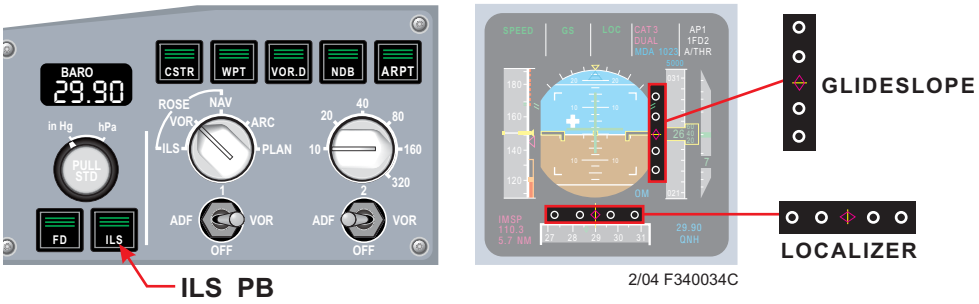
ND Vertical Prediction Depictions (continued)

Altitude Constraints

On the ND, waypoints with an altitude constraint are circled. The circle is only displayed if Managed NAV is engaged:

- Magenta when the constraint is predicted to be met
- Amber when the constraint is predicted to be missed
- White when the constraint is being ignored. A constraint is ignored when the vertical profile is not managed (DES or CLB).

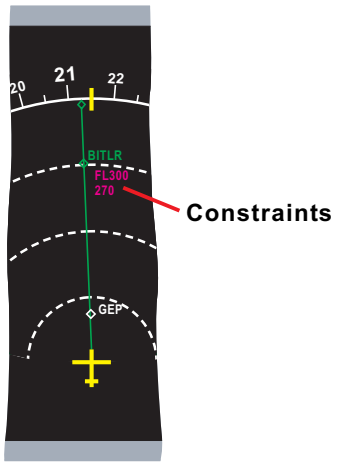


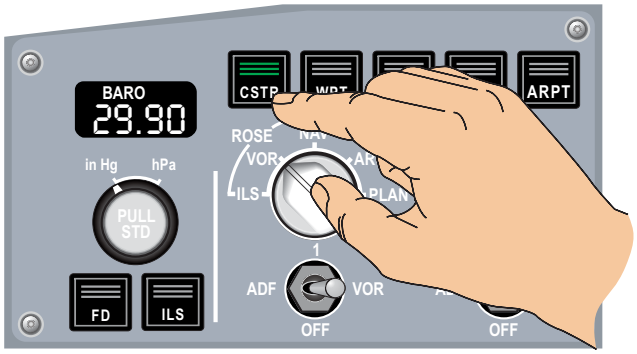
2/04 F340034C

ND Vertical Prediction Depictions (continued)

Constraint Values

The value of a flight plan altitude or speed constraint can be displayed adjacent to the waypoint in magenta by depressing the EFIS CSTR pb.





2/04 F340305C

Deceleration Point

The DECEL point symbol indicates where the FMS plans a deceleration to green dot.

If managed NAV or LOC modes are engaged and the aircraft is less than approximately 7000 feet above the destination elevation the symbol is depicted in magenta, and when crossing the DECEL point, the approach phase will automatically activate decelerating the aircraft to green dot speed. The symbol is depicted in white when managed NAV or LOC are not engaged (i.e., HDG or TRK modes are in use) and automatic approach activation cannot occur.

DECEL Symbol

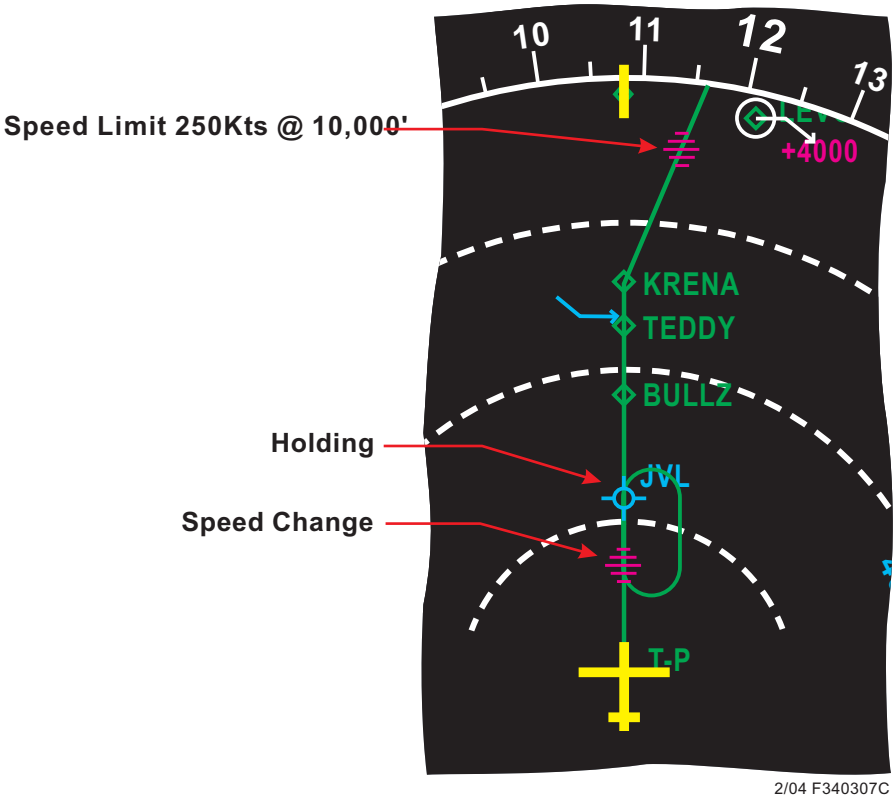
2/04 F340306C

ND Vertical Prediction Depictions (continued)

Speed Change Symbol

The magenta speed change symbol indicates where the aircraft will initiate an automatic acceleration or deceleration from the current speed. The symbol is only displayed when in managed speed. The speed change can be as a result of:

- A speed limit (always associated with an altitude)
- A speed constraint (always associated with a waypoint)
- Entering holding or exiting holding.



2/04 F340307C

Engine Out Operations

General

The FMS calculates performance capability and flight plan predictions for Engine Out (EO) situations. The FMS considers an engine out condition to exist if:

- One ENG MASTER switch is OFF
- N_2 is below idle
- There is a significant difference between thrust lever positions, with one thrust lever near idle
- The FADEC detects an engine fault.

Note: Fuel consumption in engine out situations may be increased up to 30% over two engine operations due to trim, drag and operation at a lower altitude.

EO Flight Management Effects

If an engine out condition is detected the following flight management effects occur:

Engine out flight plan predictions are computed to the destination airport. If above the EO MAX ALT (Engine Out Maximum Altitude), the predictions assume a driftdown to the EO MAX ALT at green dot, then continuation at green dot speed at the EO MAX ALT.

As soon as the EO mode is activated:

- The FMS displays the current PERF page on the MCDU.
- Driftdown predictions are provided on the PERF CRZ page if appropriate.
- The PERF page will display an EO CLR (Engine Out Clear) prompt at 1R. Selecting the EO CLR prompt restores two engine predictions and performance

  Note: Once EO CLR is selected, it is not possible to return to engine out predictions and performance unless a subsequent engine out condition is sensed (e.g., engine restart and failure). Therefore EO CLR should not be selected if an actual engine out condition has occurred.

- The PROG page title is also modified to include EO (Engine Out). When EO is displayed, the REC MAX field displays the EO MAX REC (Engine Out Maximum recommended) altitude.
- All preselected speeds entered on the PERF pages are deleted; however, these speeds can be re-entered. (Preselected speeds are speeds pre-set on the CLB or CRZ pages to take effect when the associated phase becomes active.)
- Step climbs, step descents and time constraints are deleted.

Engine Out Operations (continued)

EO mode remains active until engine recovery is detected, (when the following conditions are met);

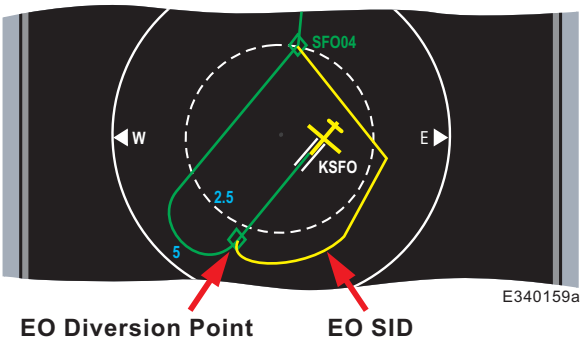
- Both FADECs are sending valid data, and
- Engine Master Switch ON, and
- N2 above idle on both engines, and
- Both thrust levers have an angle greater than 5 degrees, or
- FMGS is in DONE or PREFLIGHT phase, or
- EO CLR is pressed.

EO Flight Guidance Effects, PREFLIGHT

An engine-out SID (EOSID) may be selected from the database for the specific runway that has a EOSID defined. When the runway is selected, the associated EOSID (if available) is also selected.

If no EOSID is available, field 6C will indicate NONE.

The EOSID can be viewed on the ND in plan mode only after TMPY F-PLN insertion (continuous yellow line). EOSI overlays the normal SID selected in ACTIVE F-PLN until the diversion point, which may or may not be a fixed way point.



No change in EOSID can be made during the preflight phase. It can only be modified if EO mode is activated after take-off before reaching the EOSID diversion point.

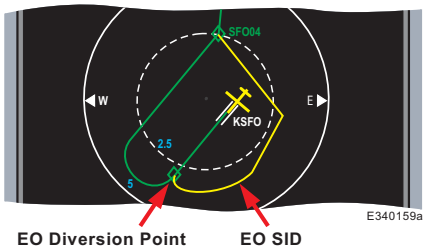
Engine Out Operations (continued)

EO Flight Guidance Effects, TAKEOFF

If an Engine Out SID (EO SID) is available for the departure runway, it automatically becomes available for use when an engine failure is detected. Each EO SID contains a diversion point which is the last point common to both the EO SID and the selected departure procedure (SID).

- If an engine failure occurs before reaching the EO SID diversion point, the MCDU presents the EO SID as a temporary flight plan on the flight plan page and the ND. The EO SID can be inserted or deleted.

  If INSERT is selected, the active flight plan is automatically replaced by the EO SID, and the destination is changed to the departure airport.



  The TMPY F-PLN starts at EOSID diversion point. Any part of the EOSID before the EOSID diversion points is ignored. A discontinuity is strung between the last waypoint of the EOSID and the remaining ACTIVE F-PLN.

  There are three options after the EOSID appears:

  - Choose to fly the EOSID by selecting TMPY INSERT prompt, or
  - Modify the TMPY-F-PLN before activation, or
  - Disregard by selecting the ERASE prompt.

- If the engine failure occurs after passing the EO SID diversion point, the ND shows the EO SID as a yellow line for display only. Both MCDUs automatically switch to the PERF page.

Inserting or deleting the TMPY F-PLN has no effect on the EO mode, which remains active. TMPY F-PLN is automatically erased in case of EO recovery or EO CLR.

Engine Out Operations (continued)

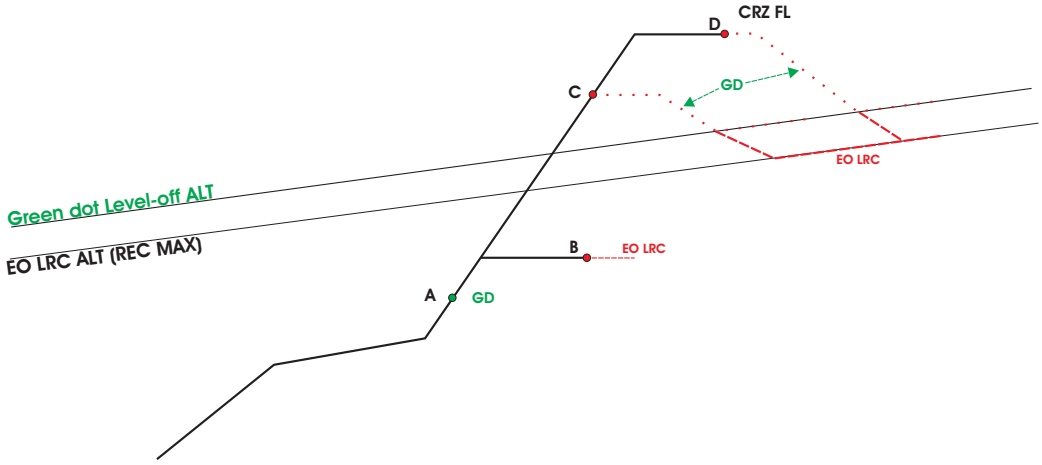
EO Flight Guidance Effects, CLIMB and CRUISE

If an engine failure occurs when the FMGS is in CLB or CRZ phase, EO mode is activated and:

- LVR MCT flashes on FMA,
- Both MCDUs switch automatically to PERF page,
- Target Speed Changes to Green Dot, or EO LRC speed if leveled at an altitude less than or equal to EO REC MAX.

Guidance and predictions for following engine failure cases are described below:

- A/C in CLIMB below EO REC MAX (Position A)
- A/C at intermediate level-off or in CRUISE below EO REC MAX (position B)
- A/C in CLIMB or CRUISE above EO REC MAX (Positions C and D)



Green Dot level-off ALT is displayed on the PERF page at LSK2R. The associated conditions are:

- Level flight
- Green Dot Speed
- MCT on good engine, anti-ice off, and failed engine windmilling
- No maneuvering margin

Engine-out Long Range Cruise ALT is REC MAX (EO REC MAX) as displayed on EO PROG page. The associated conditions are:

- Level flight
- LR cruise speed
- MCT on good engine, anti-ice off and failed engine windmilling
- Buffet margin of 0.3G
- Less than maximum certified altitude.

Engine Out Operations (continued)

EO Flight Guidance Effects, CLIMB and CRUISE (continued)

The EO managed target speed is set according to the phase of flight

In climb phase below EO REC MAX, (Position A), if speed is managed, target speed becomes green dot. No vertical mode revision occurs.

Intermediate level-off or in CRUISE phase below EO REC MAX, (Position B), if speed is managed, target speed becomes EO LRC speed. Vertical mode remains a selected.

In CLIMB or CRUISE - above EO REC MAX altitude.

- In climb, (position C), If speed is managed, target speed becomes GREEN DOT. CRZ FL ABOVE MAX FL, scratch pad message in white is triggered.
- In cruise, (position D), If speed is managed, target speed remains unchanged. CRZ FL ABOVE MAX F", scratch pad message in white is triggered.

Caution: *With aircraft altitude above MAX FL, speed will decrease.*

EO Flight Guidance Effects, DESCENT and APPROACH

If an engine failure occurs when FMGS is in DESCENT or APPROACH phase, the EO mode is activated and:

- LVR MCT flashes on the FMA
- Both MCDUs switch automatically to the PERF DES page
- Target speed remains unchanged.
- Vertical mode reverts to V/S if above EO REC MAX, stays the same if below EO REC MAX.

EO Flight Guidance Effects, GO-AROUND

If an engine failure occurs when the FMGC is in GO AROUND phase, the EO mode is activated and;

- Both MCDUs switch automatically to the PERF GO-AROUND page
- Contrary to take-off, no specific EO missed approach procedure is provided in the NAV database.
- NDs display the normal Go-around procedure.

EFIS Control Panel

General

Function

The EFIS control panels are located on the glare shield. The EFIS control panel is used to control PFD and ND displays. The EFIS control panel is described in detail in chapter 31, Flight Instruments.

2/04 F340106C

MCDUs

Function

The MCDUs are located on the pedestal, and are used to access the FMGCs and other systems. For a detailed description of MCDU keys and operations, refer to MCDU Operations.

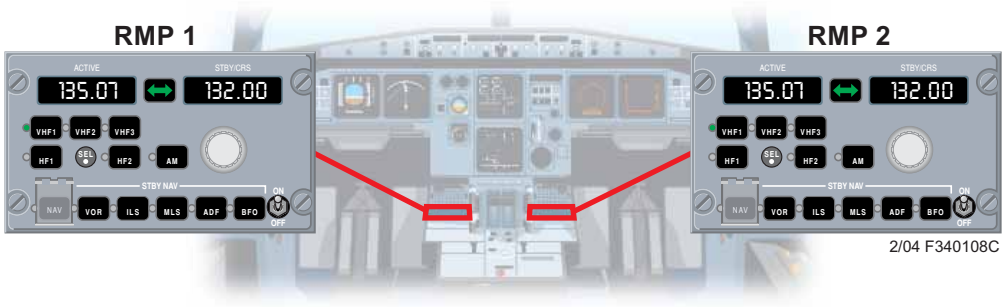
2/04 F340008C

Radio Management Panels (RMP)

The RMPs are located on the pedestals and are used when:

- Tuning communication radios (refer to chapter 23, Communications)
- Standby nav tuning of navigation radios

The RMPs are shown below.



2/04 F340108C

Standby Navaid Tuning

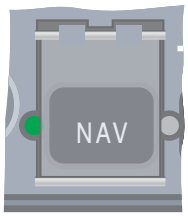
General

The navigation radios can also be tuned using the standby navaid (STBY NAV) tuning capability of the RMPs. This is usually only accomplished following a dual FMGC failure or while operating in the emergency electrical configuration.

Operation

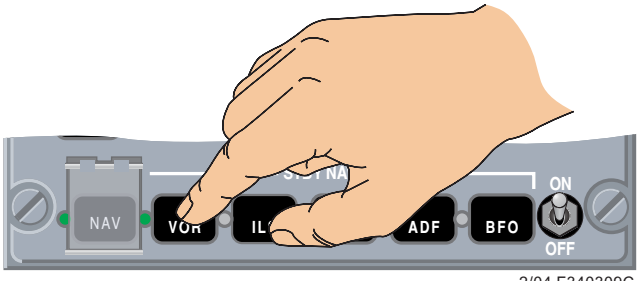
To tune navaids using STBY NAV on either RMP 1 or 2:

- The RMP power switch must be on before communication radio and standby navaid tuning is possible.
- Lift the cover and select the NAV key on.
  - The green light above the NAV key illuminates.
  - Tuning using either RAD NAV page is no longer possible
  - All navigation radios change to the last RMP tuned frequency used on that navigation radio.



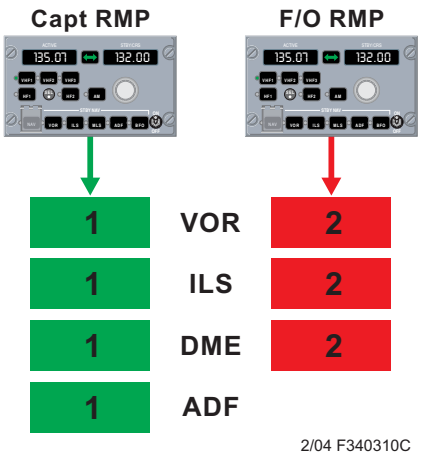
2/04 F340308C

- Push the VOR, ILS, or ADF pb for the desired nav radio to tune.



  - When selected the green light above the selected pb illuminates.
  - The last RMP tuned frequency for that radio is displayed in the STBY/CRS window.
- Select the desired frequency using the knobs and press transfer key.
  - The standby frequency becomes the active frequency.
- For VOR and ILS selections:
  - When the transfer key is pushed, the last selected course for that receiver is displayed in the STBY/CRS window.
  - Select the desired course for that receiver.

The last frequency selected using standby navaid tuning is retained by each RMP until changed. RMP 1 and 2 can each tune their on-side

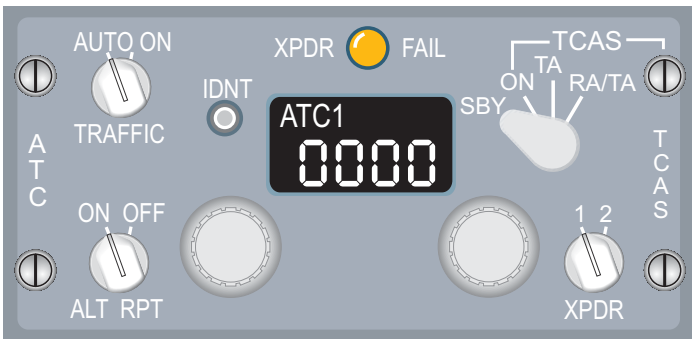


2/04 F340310C

Transponder Control Panel

Function

Transponder modes are selected with the pedestal mounted transponder control panel, as shown below. The Traffic Alert and Collision Avoidance System (TCAS) is also controlled with this panel (refer to chapter 85, Warning Systems).



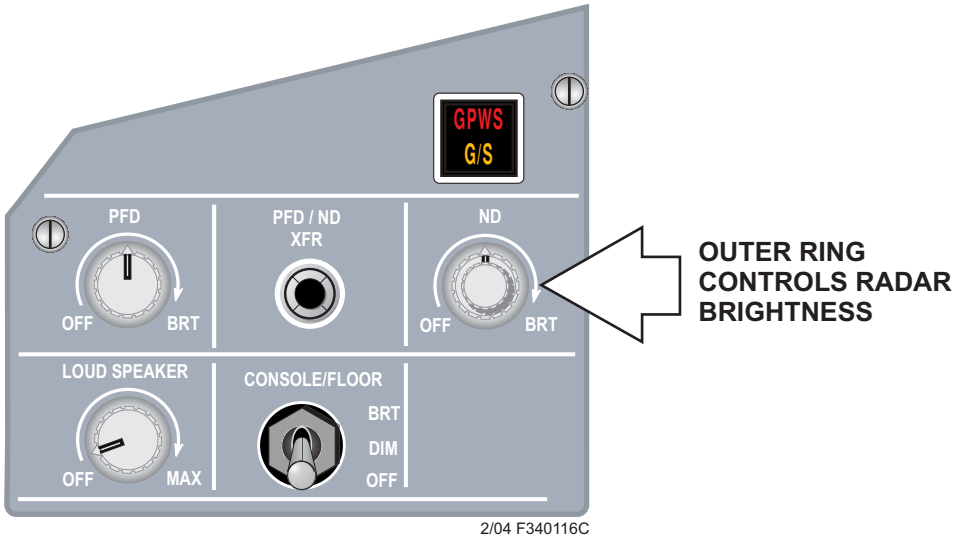
2/04 F340115C

Controls and indicators on this panel are discussed in detail in chapter 85, Warning Systems.

Radar Control Panel

Radar

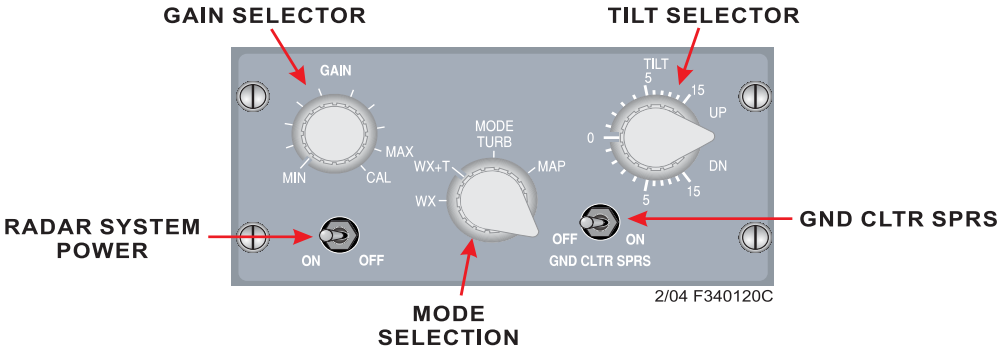
The radar image may be displayed on either ND. The radar image is controlled with the radar brightness selector on the outer ring of each pilot's ND brightness knob.



2/04 F340116C

Radar Control Panel (continued)

COLLINS Weather Radar Control Panel



Radar System Power

The radar system power switch permits the radar unit to be energized. The radar antenna transmits when the switch is selected ON.

Radar Mode Selection

When the radar mode selector is selected to:

WX: The radar display depicts levels of precipitation.

WX + T: The radar display depicts weather images and turbulence areas in precipitation. To display turbulence, the ND range must be selected to 40 NM or less.

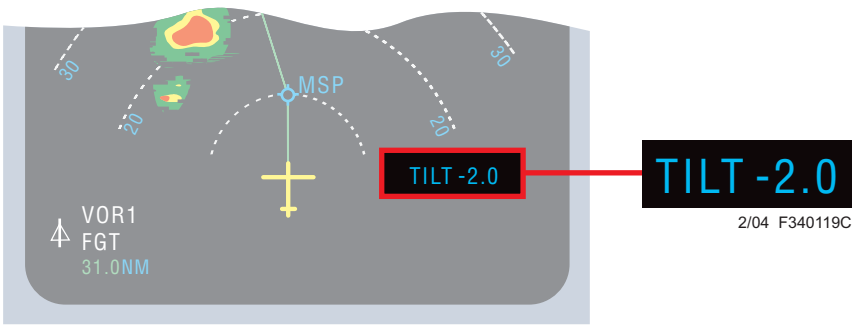
TURB: The weather images are removed, and only turbulence areas in precipitation are displayed. To display turbulence, the ND range must be selected to 40 NM or less.

MAP: Radar displays ground mapping mode.

TILT Selector

The TILT selector enables the pilot to adjust the weather radar tilt. The tilt is horizon stabilized, with 0 centering the radar beam on the horizon.

Tilt is also displayed on the ND when the radar is selected on.



The radar tilt reference is provided by the same IR as the captain's PFD.

Radar Control Panel (continued)

GAIN Selector

The GAIN selector enables the pilot to adjust the radar receiver sensitivity manually. When the GAIN is set to:

CAL — The radar receiver sensitivity is automatically adjusted for optimum radar return.

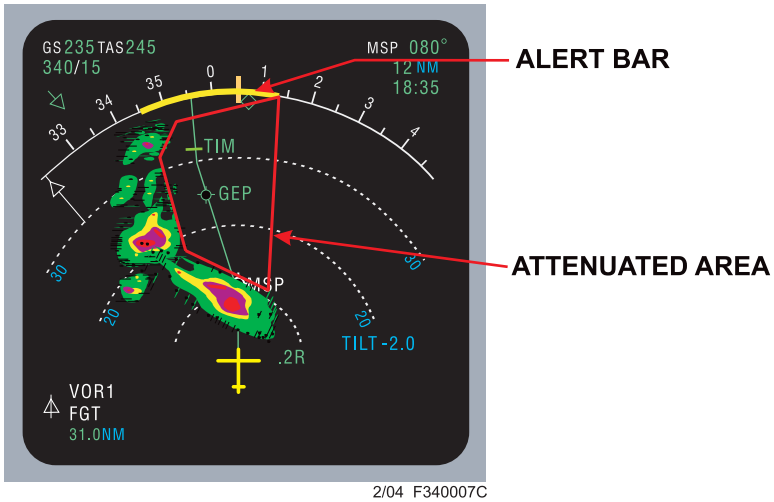
MIN/MAX — The radar sensitivity is variable. Rotating the gain selector out of the CAL position to MAX increases radar sensitivity to it's maximum setting. This equates to an increase of 3000%. Adjusting the gain can enhance the detection capability of the system at longer ranges (80 nm or more) and when at higher altitudes (FL250 and above). Active use of tilt and gain allows for the most accurate depiction of adverse weather. (See COM 3.34 for additional information).

GND CLTR SPRS

The ground clutter suppress (GND CLTR SPRS) switch is a momentary spring loaded switch that suppresses up to 85% of the ground return on the radar display. This improves the display of weather returns. The ground clutter suppression feature operates best at tilt angles between 0 and -5 degrees.

PAC (Path Attenuation Correction)

Very heavy precipitation can attenuate the radar signal, and areas of weather beyond the attenuated area may not be displayed. When severe attenuation of the radar energy is detected, a yellow alert bar is displayed at the top of the ND across the arc where attenuation has been detected. The yellow alert bar is only displayed when the intervening weather is within 80 NM of the aircraft. An example is shown below.



2/04 F340007C

ADIRS Control and Display Unit (CDU)

Introduction

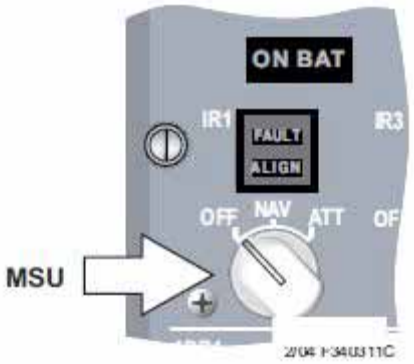
The Air Data Inertial Reference System (ADIRS) is controlled with the Control and Display Unit (CDU), located on the overhead panel. The CDU includes the three ADR pbs. The CDU is shown below:

Mode Select Unit

The rotary mode selector unit (MSU) controls the operation and alignment of each IR. The mode selector switch also controls power to the associated ADR and must be in NAV or ATT for the ADR to receive power.

OFF

Power is removed from the Air Data Inertial Reference Unit (ADIRU). The IRU and ADR units are not powered. The shutdown present position latitude and longitude coordinates are stored, along with any system faults.



ADIRS Control and Display Unit (CDU) (continued)

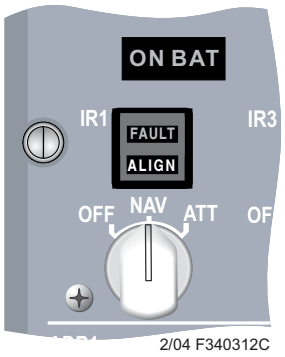
Mode Select Unit (continued)

NAV

Both the IRU and ADR units are powered.

When first selected, a normal 10 minute IRU alignment is initiated, and the align light illuminates.

If the IRU has been previously aligned, and OFF is selected for less than 5 seconds, a quick (3 minute) realignment is initiated. This is the normal position of the MSU.

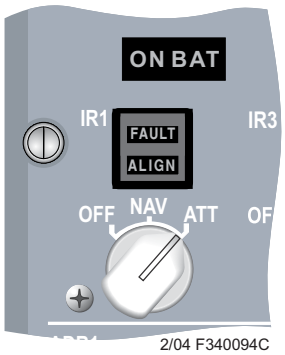


2/04 F340312C

ATT

Provides attitude information to all systems after in flight alignment is complete. Present position information is lost for the remainder of that flight. Magnetic heading is computed after initialized by the pilot.

Note: The IRU heading must be updated frequently (approximately every 10 minutes) as magnetic variation is not updated.



2/04 F340094C

ADIRS Control and Display Unit (CDU) (continued)

IR FAULT Lights

Fault Light

A steady amber FAULT light indicates a total failure of that IR.

A flashing amber FAULT light indicates that a fault has been detected in the associated IR, and attitude and heading may be recovered by performing the COM ATT alignment procedure.

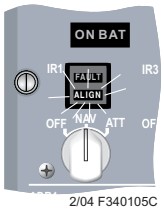
ALIGN Light

A steady white ALIGN light illuminates when the associated IRU is in the alignment phase.

A flashing white ALIGN light indicates one of the following:

- Excessive motion was detected during the alignment. A new alignment is normally automatically initiated. If the new alignment does not automatically initiate, an alignment may be possible by selecting the MSU to OFF for more than 5 seconds, and then back to NAV.
- Alignment present position has not been entered and more than 9 minutes have elapsed since NAV was selected (or more than 3 minutes during a fast realignment).
- A significant mismatch is detected (approximately 60 NM) between the alignment coordinates and the previous shutdown coordinates. A second entry of the same coordinates overrides this check.
- The IRs can measure latitude, and if the coordinates entered in the MCDU do match the IRs sensed latitude, the align lights will flash and this cannot be overridden by the pilot.

Note 1: The shutdown coordinates are set to zero during IRU maintenance and this indication is normal during the first alignment after maintenance.



The ALIGN light extinguishes automatically when the alignment phase is competed.

ADIRS Control and Display Unit (CDU) (continued)

ON BAT Light

The amber ON BAT light illuminates when one or more ADIRUs are operating on aircraft battery power. On the ground, an external warning horn sounds.

Note: This is the same horn used for the APU fire warning and avionics cooling warning.

The ON BAT light illuminates for 5 seconds when the mode selector switch is moved from OFF to NAV to verify IRU operation on battery power.

Note: The ON BAT light does not illuminate during a quick realignment.

2/04 F340080C

ADR PB

The ADR pbs control power for their respective ADR only.

The associated MSU knob must also be out of the OFF position for the ADR to be powered.

2/04 F340314C

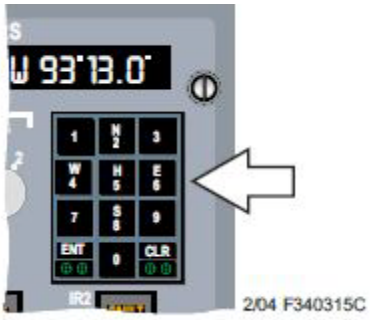
Data Display

The data display is used to display system data, messages, and to enter data using the keyboard.

Keyboard

The keyboard is used to enter data.

Note: This is not a normal procedure, all ADIRS entries are normally entered via the MCDU.



2/04 F340315C

Dual Function Keys

Some of the keys are dual function to allow the entry of north (N), south (S) etc. when entering coordinates. The “5” key is also used to enter heading (H) following an in flight IR alignment. System logic is used to automatically determine which function of the keys applies.

CLR Key

The clear (CLR) key clears the data display of data which has been typed in the display but not entered. The integral cue lights illuminate if entered data is of an unreasonable value.

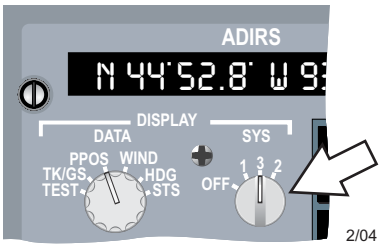
ENT Key

The enter (ENT) key enters the data on the data display. The integral cue lights illuminate when N,S,W,E, or H entry has been keyed.

ADIRS Control and Display Unit (CDU) (continued)

SYS Selector

The SYS selector is used to select a system for data display.

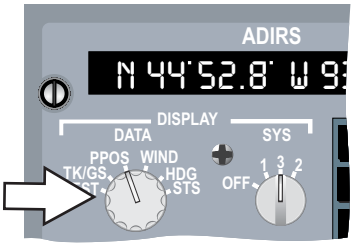


2/04 F340316C

If OFF is selected, the CDU display is not powered.

Data Selector

The display data switch allows the display of system data or messages for the system selected with the SYS Selector.



2/04 F340317C

TEST

The switch must be held in the TEST position. All segments of the data display and the ENT and CLR keyboard lights illuminate.

TK/GS

Track (true) is displayed in degrees on the left display and ground speed is in knots on the right display.

PPOS

The aircraft present position (PPOS) is displayed. Latitude (LAT) is displayed on the left display, and longitude (LONG) on the right display. During alignment, the entered LAT/LONG is displayed.

WIND

Displays wind (true) direction on the left display and velocity on the right display. The display is dashed when true air speed (TAS) is less than 100 knots.

HDG

Displays true heading. During alignment, the time to nav (TTN) is displayed as a countdown. For example, TTN 5 indicates that 5 minutes remain until the alignment is complete.

STS

Displays associated IR or ADR status (STS) messages (refer to the COM, Supplemental Procedures for a complete list).

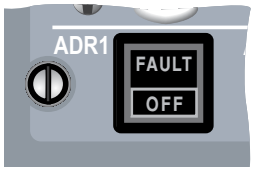
ADIRS Control and Display Unit (CDU) (continued)

ADR pbs

The ADR is powered when the corresponding IRU MSU is in the NAV or ATT positions.

ON

When the ADR pb is placed in the ON (lights out) position, the ADR is powered. The associated static ports and pitot tubes are heated in accordance with system logic (refer to chapter 30, Ice and Rain Protection).



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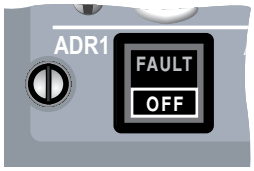
OFF

The following actions occur when the ADR pb is selected OFF:

- The white OFF light illuminates
- The ADR is not powered

Selecting an ADR pb to OFF does not affect the associated IRU.



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FAULT Light

An amber FAULT light indicates that the respective ADR has failed.

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Warning/Caution Messages

ADIRS Fault Messages

The table below lists the failures and associated warnings and cautions that can occur in the ADIRS Fault system.

E/WD Failure Condition	Aural Warning	Master Light	System Page	Local Warning
An aural stall warning is triggered when AOA exceeds normal operating limits.	Cricket + STALL (voice)	Master Warning	None	None
An aural overspeed warning is triggered when aircraft speed exceeds a configuration or aircraft limit.	CRC	Master Warning	None	None
ADR 1 (2) (3) FAULT	SC	Master Caution	None	ADR FAULT lt
ADR (1+2) (1+3) (2+3) FAULT	SC	Master Caution	None	ADR FAULT lt
IR 1 (2) (3) FAULT	SC	Master Caution	None	IR FAULT lt
IR (1+3) (1+2) (2+3) FAULT	SC	Master Caution	None	IR FAULT lt
HDG DISCREPANCY Difference between heading on Capt and F/O displays greater than 5°.	SC	Master Caution	None	CHECK HDG (on ND)
ATT DISCREPANCY Difference between roll or pitch angle displayed on Capt and F/O PFD greater than 5°.	SC	Master Caution	None	CHECK ATT (on PFD)
ALTI DISCREPANCY Difference between altitude displayed on Capt and F/O PFD greater than: - 500 ft. if baro ref STD selected - 250 ft. if QNH (or QFE) selected	SC	Master Caution	None	CHECK ALT (on PFD)
ILS 1 (2) FAULT	SC	Master Caution	None	None
RA 1 (2) FAULT	SC	Master Caution	None	None

Warning/Caution Messages (continued)

Memo Display

The following messages appear in the Memo section.

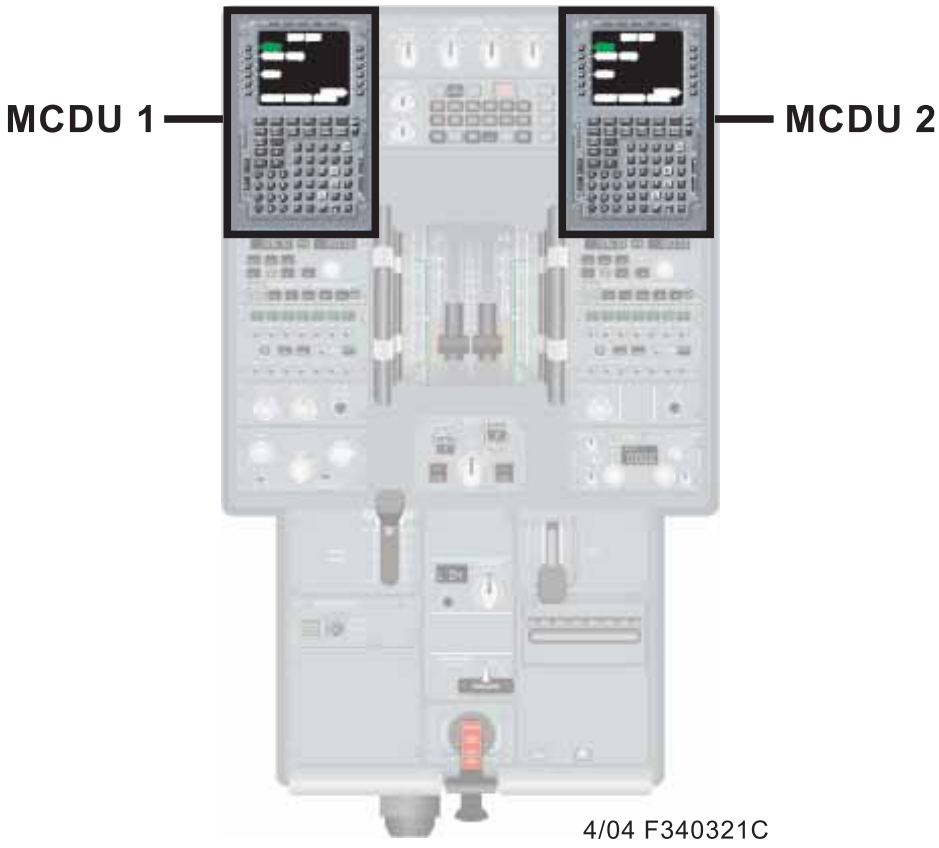
Message	Description
IRS IN ALIGN X MN	Displayed if: • at least one active IRU is in ALIGN mode, and • the remaining time until NAV mode is obtained is X mn (1 mn < X < 10 mn). The message is green if both engines are stopped. The message is amber if an engine is running.
IRS IN ALIGN	One of the three IRs is still in alignment. The message is green if both engines are stopped. The message is amber if at least one engine is running.
IRS ALIGNED	Displays in green when the IRUs are in NAV mode. The message disappears at first engine start.

Multi-Function Control and Display Unit (MCDU)

Overview

The Multi-Function Control and Display Unit (MCDU) is the primary pilot interface with the flight management system. Two identical MCDUs are located on the pedestal and are used primarily for long-term actions such as flight plan entry, monitoring and revision, insertion of gross weight, fuel, winds, temperatures, etc. FMGC messages are displayed on the MCDU.

Other systems such as ACARS and CFDS (refer to chapter 23, Communications) are accessed through the MCDU.



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Each MCDU accesses a different set of systems, as listed below:

CAPTAIN'S MCDU

To minimize potential failure modes, the captain's MCDU can only access those systems required in flight.

- FMGC
- ACARS

FIRST OFFICER'S MCDU

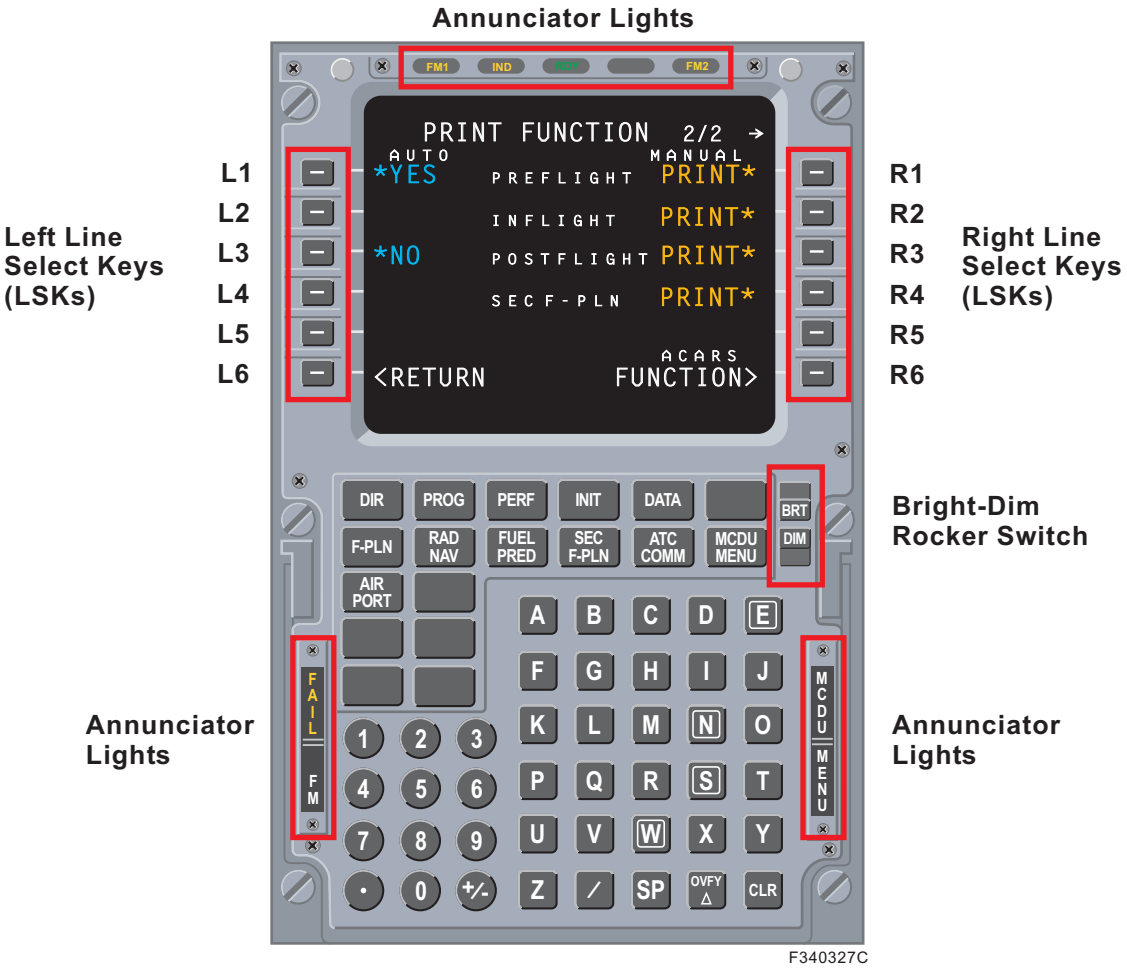
- FMGC
- ACARS
- CFDS

MCDU Layout

Display

The pilots interact with the MCDU through:

- A display screen
- Six line select keys (LSKs) on each side of the display
- BRT/DIM control (On / Off)
- A keypad
- Three sets of annunciator lights.



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Line Select Keys

There are six LSKs on each side of the display. The function of each LSK is defined by the software according to the page displayed. They are used to select items on the adjacent lines and enter information into data areas (fields) adjacent to the respective LSK.

Line select keys are referenced by number from top to bottom. On the left side, the keys are identified as 1L through 6L, on the right side, the keys are identified as 1R through 6R.

MCDU Layout (continued)

BRT / DIM Rocker Switch

Two rocker switches labeled BRT and DIM, are located on the upper right hand side of the keypad. BRT is used to power the MCDU ON and/or to increase the rightness of the screen. DIM is used to power the MCDU OFF and/or to decrease the brightness of the screen.

Keypad

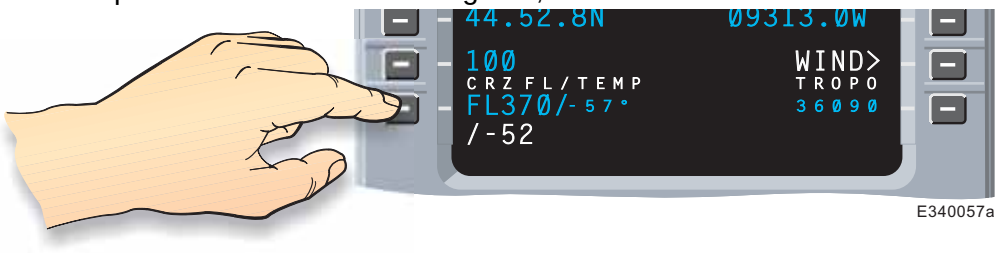
Each MCDU provides a full alpha-numeric keypad combined with mode, function, data entry, and slew functions.

Alpha-numeric keys allow entry of letters and numbers into the scratchpad successively from left to right. The SP (space) key allows entry of a space. The alpha-numeric keys are shown as follows.

The +/- key allows entry of a + or a - in the scratchpad. The first press of the key results in a - and then toggles between the +/- in the same character position with each press of the +/- key.

The / (slash) is used to separate pairs of entries in the same field. For example, airspeed and Mach (290/.79) or wind and velocity (280/15). If only the trailing entry of a pair is to be entered, it must be preceded by a /. If only the leading entry of a pair is entered, the trailing / is optional.

Example: The cruise altitude and temperature are displayed on the INIT page. The temperature input defaults to a negative value, to change only the temperature at FL310 to -52 degrees, either “/-52” or “/52” could be entered.



Note: A few fields require both entries to be changed simultaneously. If an attempt is made to change only one entry of a pair, and it is not allowed, a FORMAT ERROR message is displayed in the scratchpad.

Note: The zero key and the letter “O” are not interchangeable. A numeric entry, for example “100.5”, requires the use of the zero key.

MCDU Layout (continued)

Annunciators

Three sets of MCDU annunciator lights are installed

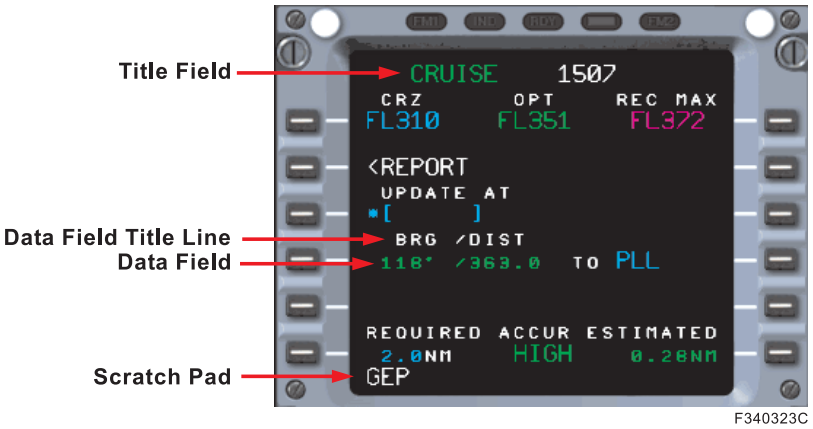
- FM1 or FM2 lights (amber) - The corresponding light will illuminate if the on-side FMGC has failed, FM1 for the captain's FMGC, FM2 for the first officer's FMGC. Both indicators cannot illuminate on the same MCDU, except during a light test. Since MCDUs may be installed in any position, all MCDUs contain both FM1 and FM2 lights.
- IND (amber) - The IND (independent) light indicates an independent mode of FMGC operation. In this case both FMGCs are operational, but are operating independently and not exchanging data. An INDEPENDENT OPERATION amber scratchpad message will also be displayed.
- RDY (green) - The RDY (ready) light indicates the MCDU has passed its power up test after pressing the BRT rocker switch.
- FAIL (amber) - If the FAIL light is illuminated, the MCDU is not operating properly.
- FM (white) - The FM (Flight Management) light illuminates when the MCDU is linked to another system (e.g., ATSU) and the FMGC is attempting to display a scratchpad message.

  For example, if the ATSU system has been selected and the FMGC is attempting to display a scratchpad message, the light illuminates. Pressing any FMGC related MCDU key or selecting the FM prompt on the MCDU MENU page allows viewing of the message and clears this annunciation.
- MCDU MENU (white) - If the MCDU MENU light is illuminated, a system linked to the MCDU requests the display. The system requesting the display has a REQ prompt adjacent to the system title on the MCDU MENU page. Selecting the requesting system clears this annunciation.

MCDU Display

Display Screen

The display consists of 14 lines comprising the title field, the data fields and the scratchpad.



- Title Field - This field is the top line of the display. It displays the page's title. In some instances it will also display a page number or arrows indicating the availability of additional pages with the use of the page keys.
- Data Fields - Data display locations vary by the individual page's layout. Data fields often are comprised of a title line in small font above the data. Data displayed directly adjacent to each line key is generally accessible with the line select key. Data displayed in small font is generally computer generated. Data displayed large font is generally pilot entered.
- Scratchpad - This field is the bottom line of the display. Pilot keypad entries are displayed on this line, as well as messages generated by the system currently being accessed (e.g., FMGC, ATSU). When used with the FMGC, the scratchpads for the two MCDU's operate independently for data entry. When connected to the same system, e.g., ACARS, scratchpad entries are displayed on both MCDUs simultaneously. A maximum of 22 characters can be entered.

  Because messages are composed in the scratchpad, and then entered in another position, there are no LSKs associated with the scratchpad.

MCDU Display (continued)

Page and Slew Keys

Data is presented on the MCDU display screen in either a single or multiple page format. For example, the RAD NAV (radio navigation) page has a single page for display of information, whereas the PERF (performance) pages for each phase of flight: takeoff, climb, cruise, etc. The first page of each set of pages is displayed by pushing a labeled key. For example, the PERF page for the current flight phase is displayed by pushing the PERF key, as shown below.

Once the basic page is selected, other related pages of a set are accessed by using the page keys **(←→)** or prompts on the page. If additional pages are available with the page keys, left and right arrows are displayed in the upper right corner to indicate the key(s) that select additional pages. Some systems will display page numbers, and the total number of pages available. For example 1/4 indicates that page 1 of 4 is displayed. Pages 2 through 4 are displayed using the page keys.

If a page's contents are too long to fit on one page (typically the flight plan page), the display can be slewed up or down using the slew keys **(↑↓).** Arrows in the lower right corner indicate the permitted slewing directions.

The slew keys are also used to adjust the ADIRS initial alignment coordinates. (refer to IRS INIT page). Slew capability is indicated by arrows in the lower right corner of the display. Slewing may be limited to either just up or down, indicated by a single corresponding slew arrow. If slewing is attempted in a direction not available, a NOT AVAILABLE message is displayed in the scratchpad.

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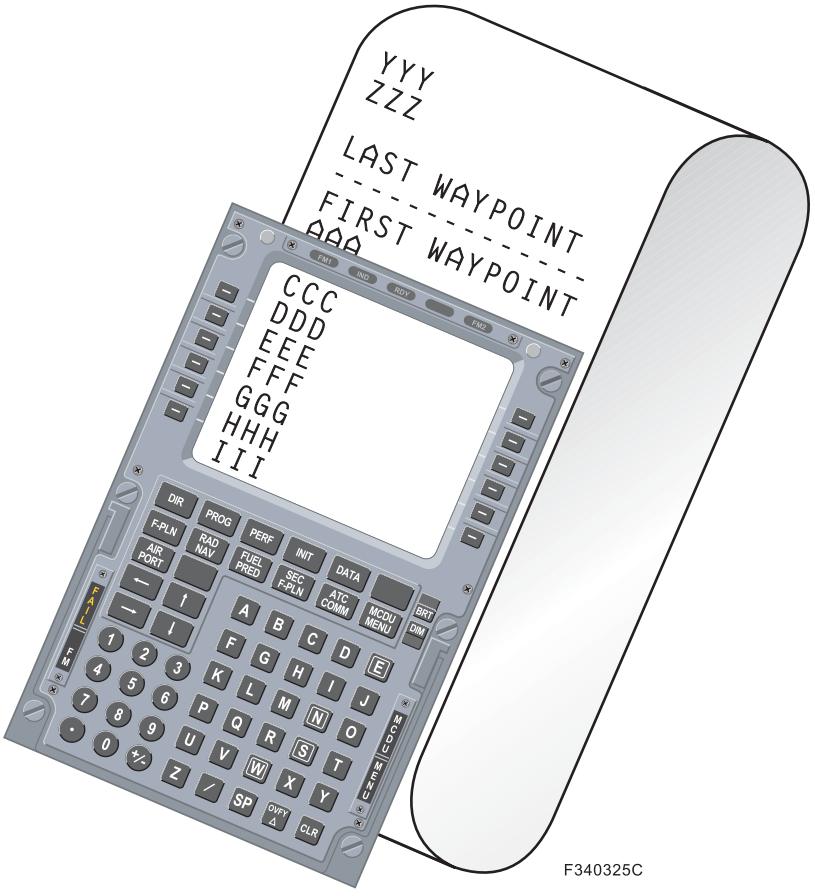
MCDU Display (continued)

Slewing the Flight Plan

When slewing the flight plan page, the operation can be envisioned as slewing a paper flight plan list behind the window of the MCDU. Pushing the ↑ key slews the flight plan up so that items contained later in the flight plan are displayed. Continued slewing will eventually display the end of the flight plan, followed by the beginning of the flight plan, in a continuous loop.



MCDU Data

Data Fields

A data field is a specific area of the display. It may consist of display only, mandatory entry, or optional fields.

Display only data fields are typically green in color and may be in large or small fonts.

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The amber boxes are displayed in this field, indicating that an entry in this field is mandatory. The pilot must enter the departure ICAO identifier, a slash (/), and the destination ICAO identifier in the FROM/To field. This data field requires four characters for each field. For example, if the flight was from MSP to MEX, the entry would require KMSP/MMMX.

Optional entries are displayed as blue brackets if the field currently has no value inserted, or blue values if a value already exists for the field.

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Other fields may require a slash (/), a period (.), or other symbols. If the data does not meet the required format, a FORMAT ERROR message is displayed in the scratchpad:

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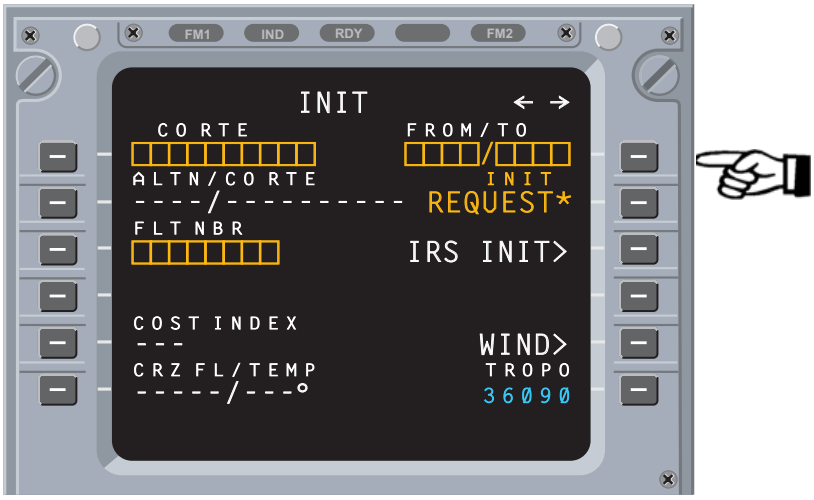
If the pilot attempts to enter data into a field where it is not allowed, a NOT ALLOWED message is displayed.

413

MCDU Data (continued)

Data Entry

Data is entered into any field by first typing the entry into the scratchpad, then pushing the LSK adjacent to the desired field. The data must be in the proper format, including all necessary symbols.



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The entry must be within preset limits for entry. If an entry is out of the allowable range, an ENTRY OUT OF RANGE message is displayed. For example, trying to enter a frequency which is too high (e.g., “215.5,” as a VOR frequency) would result in the ENTRY OUT OF RANGE message being displayed.

Data fields presented at the center of the display are for display only, and it is not possible to access them directly via line select keys.

Simultaneous MCDU Entries

Both pilots can make entries simultaneously on the same or different MCDU pages, or on different lines of the same page. However, simultaneous entries on the same page are not recommended. Only one flight plan modification at a time will be processed.

The MCDU “remembers” all keystrokes made from either MCDU. The pilot is able to make key strokes faster than the MCDU can update the display. This can result in undesirable consequences. For example, caution should be used when clearing multiple lines in the flight plan to avoid clearing too many entries.

MCDU Data (continued)

Use Of Color

Color is used on the MCDU to simplify interpretation of displays. The color of MCDU displays and corresponding ND information is the same in most cases. The use of color follows these general rules:

WHITE is used to display titles, data field labels, page selection prompts, and other messages. The secondary flight plan is also white, along with data regarding the TO waypoint and destination.

BLUE is used to inform the crew that data in this field can be modified by the pilot. If the data is FMS generated, it is displayed in small font. If the data is pilot entered, it is in large font. Flight plan missed approach and alternate routings are also displayed in blue.

AMBER signifies that the item is significant and indicates one of the following:

- Items and scratchpad messages requiring immediate attention
- A mandatory entry
- A change in the aircraft flight path or speed will occur if selected
- A flight plan constraint is predicted to be missed
- Pilot confirmation of the selection is required

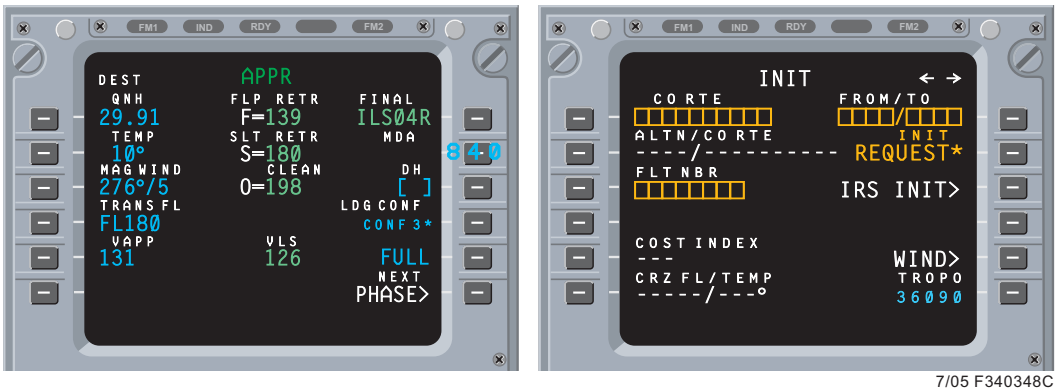
MAGENTA identifies flight plan constraints that the FMGC predicts will be met.

GREEN is used for the active flight plan waypoints (except the TO waypoint) and FMGC data that cannot be modified by the pilot.

YELLOW is used to display a temporary flight plan.

SCRATCHPAD MESSAGES
Scratchpad messages which are significant are displayed in amber. Those of lesser importance are displayed in white.

The page below illustrates several uses of the various colors.



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MCDU Data (continued)

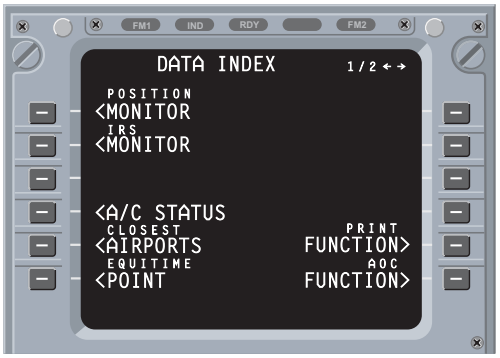
Symbols

Prompt, asterisk, and arrow symbols each have unique meanings that indicate the expected behavior when selected or displayed.

Prompts

Selecting a prompt with a < or > symbol next to it selects another page.

For example, the prompts displayed on the DATA INDEX page below allow access to each of the listed pages.



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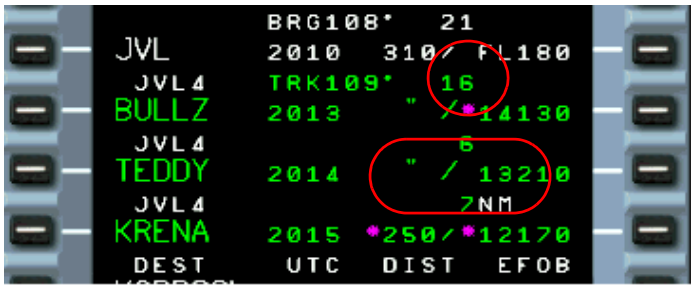
Constraint Asterisk

An asterisk located adjacent to a speed or altitude constraint indicates whether the aircraft is capable of honoring the constraint. The asterisk is either:

- Magenta if the constraint is predicted to be honored
- Amber if the constraint is predicted to be missed



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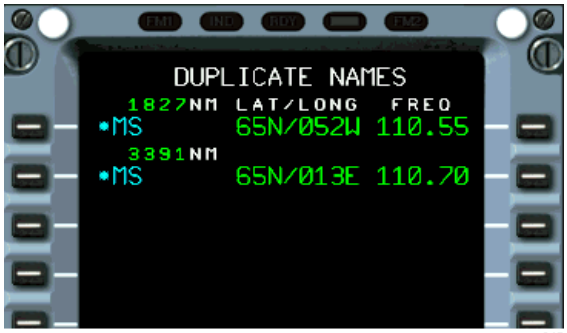
MCDU Data (continued)

Symbols (continued)

Choice asterisk

The asterisk is presented when the selection will change parameters affecting the active situation. Pushing a LSK adjacent to the * asterisk indicates that this choice will be selected without further confirmation (e.g. selecting a particular navaid from a list of many).



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Note: Waypoints and NAVAIDs are listed in order of distance from the aircraft once the alignment process is complete.

Choice Arrows

Pushing a LSK adjacent to this arrow indicates that this choice will replace the current selection.

In a list of this type, the current selection (ILS09L) does not have an adjacent arrow.

ILS04R and ILS09R are available menu options and selecting the LSK adjacent to either arrow will select the corresponding choice.

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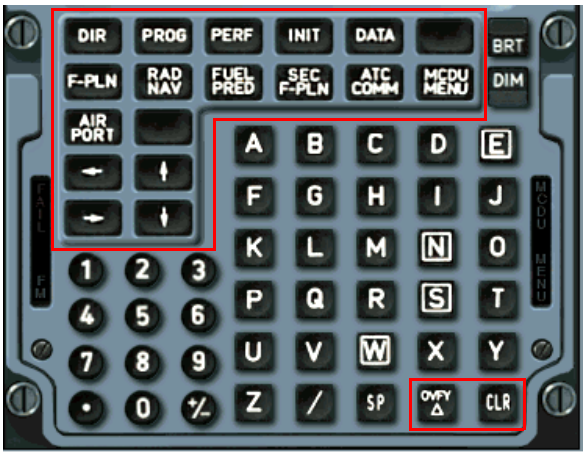
MCDU Key Functions

Function and Page Keys

The function and page keys are used to access MCDU pages or select desired functions. Most of these pages then allow access to other pages in that set. If the MCDU is being used to access a system other than the FMGC (ACARS, for example), pushing an FMGC related page key (e.g., the PERF key) directly accesses the FMGC.

Each MCDU can be used to access a different page. These keys are shown below:



Each key is described briefly below. All functions associated with each key are discussed in detail later.

CLR Key

The CLR (clear) key allows entries to be cleared from the display field and messages from the scratchpad, or individual characters that have been typed into the scratchpad.

OVFY Key

The OVFY (overfly) key allows the designation of a waypoint that must be overflown before a turn is initiated.

SLEW Keys

The slew keys (↑↓) allow the contents of the page to be scrolled up or down when the entire contents of a page cannot be displayed at one time.

Page Keys

The page keys (←→) display additional pages in the set.

MCDU Key Functions (continued)

DATA Key

The DATA key selects the data index page which provides access to additional pages that display position, aircraft status, database items, and pilot stored data.

INIT Key

The INIT (initialization) key displays the flight plan initialization page. Initial weight, CG, fuel, and fuel requirements are entered during preflight on the INIT pages. The INIT pages are accessible at any time, however some fields cannot be modified after engine start.

PERF Key

The PERF (performance) key displays the aircraft performance page. A PERF page for each phase of flight displays the optimum speed and other performance related data.

PROG Key

The PROG (progress) key displays the progress page. The PROG page displays navigation information, and optimum and maximum altitude data. The page also provides a means to update the FMS position and allows the pilot to determine the bearing and distance to any waypoint.

DIR Key

The DIR (direct) key is used to select a waypoint to proceed directly to, or to use for interception of a specific radial.

F-PLN Key

The F-PLN (flight plan) key displays the active flight plan page. This page allows access to other flight plan pages, such as the ARRIVAL, DEPARTURE, REVISION, and HOLDING pages.

RAD NAV Key

The RAD NAV (radio navigation) key displays the RAD NAV page. This page displays navaids automatically tuned by the FMGC and allows navaids to be manually tuned.

MCDU Key Functions (continued)

FUEL PRED Key

The FUEL PRED (fuel prediction) key displays the FUEL PRED page. This page displays fuel and time predictions, and FMGC calculated fuel and gross weight.

SEC F-PLN Key

The SEC F-PLN (secondary flight plan) key displays the (SEC INDEX) secondary index page. This page allows access to the secondary flight plan, secondary initial pages, and secondary performance pages.

ATC COMM Key

Selects the ATC MENU for datalink communications with ATC.

Note: This system is for a future system upgrade and is currently unavailable.

MCDU MENU Key

The MCDU MENU key allows selection of various systems linked to the MCDU. For example, the ACARS system is selected from the MENU on this page.

AIRPORT Key

The first depression of the AIRPORT key displays the flight plan page. Subsequent depressions step the flight plan to each airport in the flight plan (departure, destination, alternate) in turn, allowing quick access.

Clear Key

Use of the CLR Key

The clear (CLR) key is used to clear messages and data from the scratchpad or an individual data field as follows:

If the same message is displayed in both scratchpads, a single push of the CLR key will clear the message from both MCDUs.

If alpha numeric characters have been entered into the scratchpad, a single short press of the CLR key erases the last character entered. A longer press of the key erases the entire scratchpad.

If the scratchpad is empty, operation of the CLR key enters the legend CLR into the scratchpad. To clear a particular display field, the adjacent LSK is then selected.

Pressing the CLR key, then pushing LSK 4L will bring up the TMPY (temporary) flight plan with BAE cleared. Inserting the TMPY by pushing LSK 6R will then complete the clearing process.

The CLR key must be depressed each time a different waypoint or field is cleared. (either in the active or temporary flight plan)

The CLR legend can be removed from the scratchpad by depressing the CLR key a second time.

Clear Key (continued)

Use of the CLR Key (continued)

If a data field containing a numeric value is cleared, the field reverts to the default value, FMS calculated value, “Blue Brackets, or “Amber Boxes”, as appropriate.

Example: For example, the pilot has entered a transition altitude on the PERF TAKEOFF page of 10,000 feet (as indicated by large blue font). The default value for the transition altitude is 18,000 feet. Clearing the data field results in the default value being displayed, as shown below.

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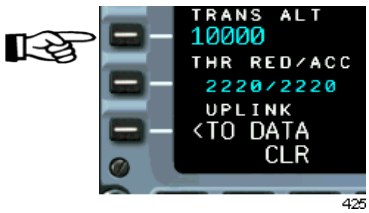

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Several FMGC automatically generated waypoints (known as pseudo waypoints) automatically clear during flight plan calculations. As a result, more than one flight plan line may erase as a result of a CLR entry. Clearing waypoints from the flight plan must be done one at a time, with a short pause between clearing actions to allow the page to update (including the temporary flight plan).

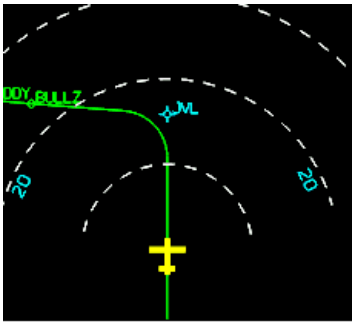
Depressing the CLR key with a scratchpad message displayed clears the message from both MCDUs. However, clearing the message does not correct the underlying cause for the message. For example, if the message RWY/ILS MISMATCH is displayed, depressing the CLR key removes the message, but does not change the selected ILS frequency.

Note: Once cleared, scratchpad messages cannot by recalled by the crew.

Overfly Key

Description

The overfly (OVFY) key forces the aircraft to overfly a waypoint before turning. Normally, the aircraft will start the turn before a waypoint so that it ends up on the center of the next airway leg, as shown in the example at JVL



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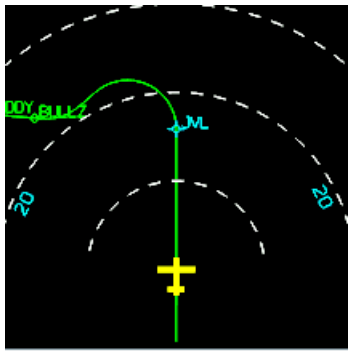
If overfly is selected, the aircraft will overfly the waypoint before turning. The overfly symbol is displayed adjacent to the JVL waypoint in the example below.



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If overflying the waypoint is no longer required, the overfly symbol should be reselected and inserted onto the current overfly point in the flight plan. This will create a TMPY flight plan with the overfly symbol removed. Inserting the TMPY flight plan will return the waypoint to a non-overfly point. This action clears the overfly symbol while allowing flight plan contraints (airspeed and altitude) to remain.

MCDU Operations

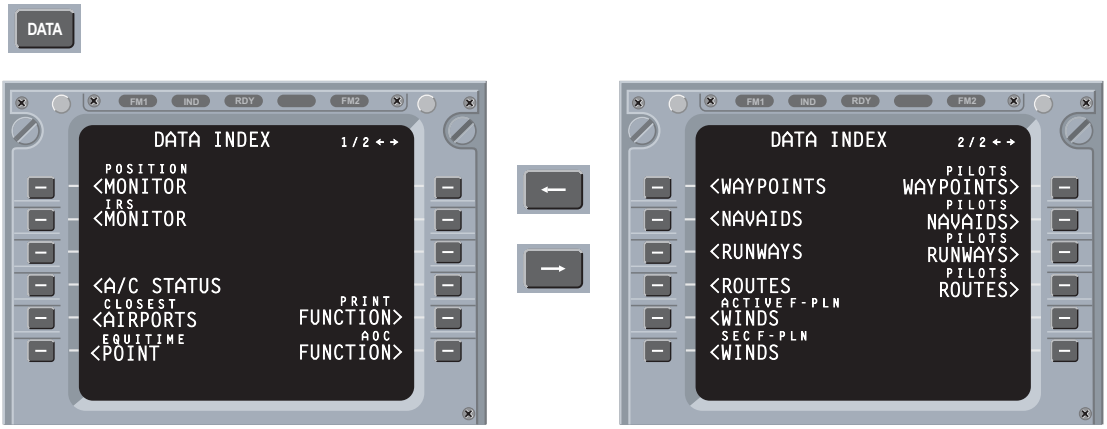
DATA INDEX Pages

General

The DATA INDEX page 1 provides access to various pages associated with navigation data. DATA INDEX page 2 provides access to pages related to the navigation database and manually stored waypoints, navaids, runways, and routes.

DATA INDEX

The DATA INDEX page is accessed with the DATA key.



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POSITION MONITOR

The POSITION MONITOR prompt displays the POSITION MONITOR page, which displays the various positions available to each FMGC.

IRS MONITOR

The IRS MONITOR prompt displays the IRS MONITOR page, which displays the respective status of each IR during alignment and in-flight. In addition, it provides the total system drift value for each respective IR at the completion of the flight.

A/C STATUS

The A/C STATUS prompt displays the AC STATUS page., which displays the aircraft and engine type, current navigation database, PERF and IDLE factors, and the number of manually stored elements.

CLOSEST AIRPORTS

The CLOSEST AIRPORTS prompt displays the CLOSEST AIRPORTS page, which provides indication of the four closest airports from PPOS. In addition, it provides a fifth pilot selectable airport.

EQUITIME POINT

The EQUITIME POINT prompt displays the EQUI-TIME POINT page, which displays a pseudo-waypoint in the lateral flight plan from which the times to reach two designated reference points are equal.

DATA INDEX Pages (continued)

PRINT FUNCTION	The PRINT FUNCTION prompt displays the PRINT FUNCTION page. These pages are provided for printing of data related to the current flight plan.
AOC FUNCTION	The AOC FUNCTION prompt displays the AOC FUNCTION page. The functions associated with these pages are currently unavailable.
WAYPOINTS	The WAYPOINTS prompt displays the WAYPOINT page, which displays information from the database about the selected waypoint.
NAVAIDS	The NAVAIDS prompt displays the NAVAIDS page, which displays information from the database about the selected navaid.
RUNWAYS	The RUNWAYS prompt displays the RUNWAYS page, which displays information from the database about the selected runway.
ROUTES	The ROUTES prompt displays the ROUTES page, which displays information from the database about the selected route.
ACTIVE F-PLN WINDS	The ACTIVE F-PLN WINDS prompt selects the CLIMB WIND page. From this page all climb, cruise, and descent winds can be entered into the active flight plan.
SEC F-PLN WINDS	The SEC F-PLN WINDS prompt selects the SEC CLIMB WIND page. From this page all climb, cruise, and descent winds can be entered into the secondary flight plan.
PILOTS WAYPOINTS	The PILOTS WAYPOINTS prompt displays the PILOTS WAYPOINT page, which displays information from the database about manually created waypoints.
PILOTS NAVAIDS	The PILOTS NAVAIDS prompt displays the PILOTS NAVIAD page, which displays information from the database about manually created navaids.
PILOTS RUNWAYS	The PILOTS RUNWAYS prompt displays the PILOTS RUNWAYS page, which displays information from the database about manually created runways.
PILOTS ROUTES	The PILOTS ROUTES prompt displays the PILOTS ROUTES page, which displays information from the database about manually created routes.

DATA - POSITION MONITOR

General

The POSITION MONITOR page displays various aircraft computed FMGC position information and related IR position information.

GPS HYBRID

GPS AUTONOMOUS

FMGC1 and FMGC2

Line 1 displays the computed latitude/longitude of the number 1 FMGC. Line 2 displays the computed latitude/longitude of the number 2 FMGC.

Navigation Mode

Navigation mode. In the first two examples above the FMGC 1 navigation mode is 3IRS and GPS. In the third example, the FMGC 1 navigation mode is 3 IRS and DME/DME.

GPIRS/GPS

The GPIRS navigation field displays the GPS data as processed by the ADIRS and sent to the FMGCs (hybrid).

The GPS navigation field displays the GPS data as acquired and processed by the FMGCs (autonomous).

RADIO (GPS unavailable)

The RADIO navigation field displays the computed latitude/longitude position computed by the on-side FMGC. If a radio position is not computed, this line is blank.

DATA - POSITION MONITOR (continued)

MIX IRS

The MIX IRS field displays the computed latitude/longitude position of the averaged position of all three IRS's.

IRS 1, IRS 2, and IRS 3

This line displays the current mode of each IRS and the deviation in nautical miles between each IRS position and the pilot's own FMGC position. The possible IRS modes are:

- (NAV) - Navigation
- (INVAL) - Invalid
- (ALIGN) - Alignment
- (ATT) - Attitude

IRS position deviation is only displayed when the IRS mode is NAV.

FREEZE/ UNFREEZE

This prompt allows the pilot to freeze the information displayed for easier comparison for recording purposes. If the freeze function is activated, the title line displays POSITION FROZEN AT (clock time). Freezing the information displayed on this page does not affect the functioning of the navigation systems.

When FREEZE is selected, the prompt changes to UNFREEZE.

Selecting the UNFREEZE prompt or exiting the page unfreezes the information.

SEL NAVAIDS

Selecting SEL NAVAIDS prompt displays the SEL NAVAIDS page.

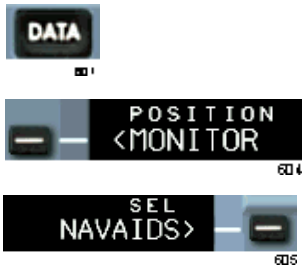
DATA - POSITION MONITOR - SEL NAVAIDS

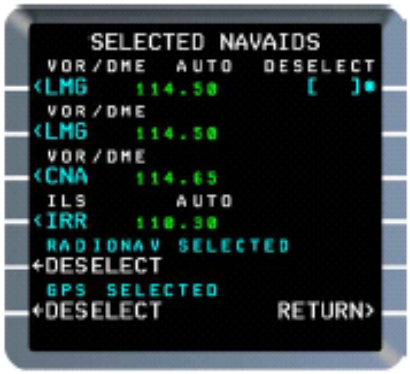
General

The selected navaids (SEL NAVAIDS) page allows the monitoring of the navaids autotuned by the FMGC for navigation and display purposes. This page displays the navaids selected by the on-side own FMGC only.

RADIONAV and GPS can be deselected from this page, thus removing all RADIONAV and/or GPS inputs from position computations.

To access additional information about any of the displayed navaids, select the adjacent LSK. This displays the NAVAID page corresponding to the navaid.





Line 1

The navaid tuned by the on-side FMGC for ND display purposes is depicted on this line. The type of navaid is displayed in white, along with an indication of the method of tuning (e.g., AUTO, MAN, or RMP). In the example above, the JVL VOR/DME has been autotuned for display.

On the captain's MCDU, this line corresponds to the navaid tuned for VOR 1. On the first officer's MCDU, this line corresponds to the navaid tuned for VOR 2. The identifier for the navaid is blank when manual tuning has occurred on a frequency not in the database.

The information displayed on this line is also displayed on the RAD NAV page for the corresponding VOR.

During FMGC VOR/DME navigation this VOR/DME is also used for FMGC navigation.

Line 2 and 3

These lines display the navaids used by the FMGC for calculation of the radio position.

Line 4, ILS

This line displays the tuned ILS frequency. It can be tuned automatically by the FMGC or manually tuned using the MCDU or RMP.

The FMGC uses an ILS localizer for position updating when the LOC flight guidance mode is engaged and the aircraft is within 20 nautical miles of the localizer.

This line is only displayed when an ILS frequency has been tuned.

DATA - POSITION MONITOR - SEL NAVAIDS (continued)

RETURN

Selecting this prompt returns the display to the POSITION MONITOR page.

RADIONAV DESELECT LSK [5L]

Enables deselection and selection of all RADIONAV inputs to the FMS for position computations. If the aircraft is within 80nm of T/D, or if the FMGS is in the APPR phase, a MCDU s-pad message "RADIONAV IS DESELECTED" is displayed (amber).

The pilot can deselect up to 6 navaids. The identifier of navaids deselected are listed below the title. When deselected, the navaid will not be autotuned or used by the FMGC for navigation. Deselecting a VOR that has been NOTAMed as unreliable prevents its use by the FMGC for navigation.

Clearing a navaid ident from the DESELECT list allows it to be used again. All deselected navaids are cleared at the end of the flight when the DONE phase occurs or if the secondary NAV Database is activated.

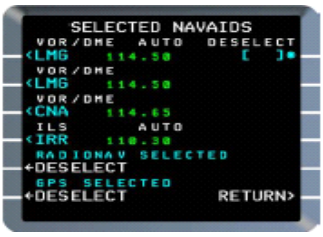
In the example below, LMG, SFD, RBT, and CNA VORs have been deselected.

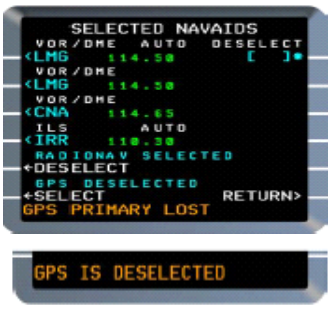
Once RADIONAV has been deselected, the prompt at line 5 changes to "SELECT" to enable selection of RADIONAV.

Upon transition to the DONE phase, RADIONAV reverts to the default status (SELECTED)

GPS DESELECT LSK [6L]

Enables deselection and selection of GPS inputs to the FMS for position computations. If the aircraft is within 80nm of T/D, or if the FMGS is in the APPR phase, a MCDU s-pad message "GPS IS DESELECTED" is displayed (amber). GPS PRIMARY LOST is displayed in the MCDU s-pad and on the ND. Use of GPS inputs for a/c with hybrid GPIRS installation is inhibited.





Once GPS has been deselected, the prompt at line 6 changes to "SELECT" to enable selection of GPS.

Upon transition to the DONE phase, GPS reverts to the default status (SELECTED)

DATA - IRS MONITOR

General

The IRS MONITOR page displays IRS data and allows selection of detailed data for each IRS

IRS 1 (2/3)

Each IRS prompt displays the associated IRS pages. Each line displays the current mode of the IRS (ALIGN, NAV, ATT, or INVAL). If the IRS is in ALIGN mode, the time to align is displayed. At the completion of the flight, the average drift is displayed in nautical miles per hour. This is an example of an IRS page in-flight

Messages

The following messages can be displayed next to each IRS as appropriate.

- IR FAULT
- DELAYED MAINT
- ENTER PPOS
- SELECT ATT
- EXCESS MOTION
- SWITCH ADR
- CHECK CB
- CDU FAULT
- ENTER HEADING
- REENTER PPOS
- SYS BELOW -15

DATA - IRS MONITOR (continued)

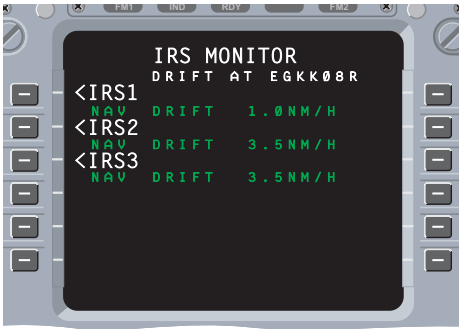
Drift Display

The IRS MONITOR page displays each IRS's drift at the completion of the flight.

Upon landing, the FMS memorizes the IRS and FMGC positions, It calculates:

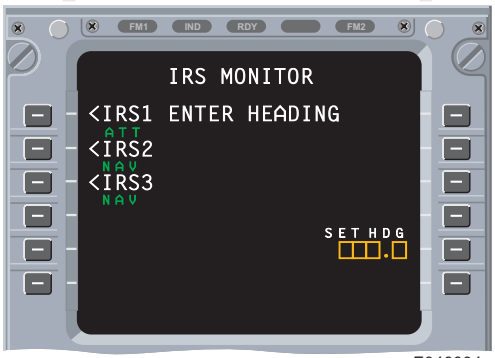
- The landing position based on a standard offset from the selected landing runway's threshold position.
- The position error for each IRS, based on the difference between each IRS's position and the landing position.
- The hourly drift rate for each IRS based on each IRS's position error and the time since the first IRS entered the NAV mode.

After Engine shutdown (FMS DONE phase) the IRS MONITOR page displays the landing runway used to calculate the landing position and the drift rate for each IRS in NM/hour.



SET HDG

This field is displayed only if the IRS is in the ATT mode, and allows initialization of the heading for use in ATT mode. If a heading has not been entered, the field is displayed as amber boxes. If a heading has been entered, the field is displayed in blue.



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DATA - IRS MONITOR - IRS 1 (2/3) Pages

General

The IRS pages display various IRS parameters.

Title Line

The IRS 1 (2/3) title displays the selected IRS. If the data displayed on the page is frozen, the line is replaced by IRS FROZEN AT and the time the FREEZE prompt was selected.

POSITION

The POSITION field displays the latitude/longitude as determined by the respective IRS.

TTRK

The TTRK field displays the true track as determined by the respective IRS.

THDG

The THDG field displays the true heading as determined by the respective IRS.

WIND

The WIND field displays the wind (relative to true north) as determined by the respective IRS.

GS

The GS field displays the ground speed as determined by the respective IRS.

MHDG

The MHDG field displays the magnetic heading as determined by the respective IRS.

NEXT IRS

The NEXT IRS prompt selects the next individual IRS page in a closed loop (1-2-3-1-2 etc.).

DATA - IRS MONITOR - IRS 1 (2/3) Pages (continued)

FREEZE/ UNFREEZE

The FREEZE/UNFREEZE prompt allows the data on the display to be frozen on all three IRS pages. when the data is frozen, the time that the FREEZE was selected is displayed in the title. The page is automatically unfrozen when the page is exited.

DATA - A/C STATUS Page

A/C STATUS Page

The aircraft A/C STATUS page allows the crew to review the FMS aircraft performance database (aircraft and engine type), and the navigation database cycle. The number of manually created routes, waypoints, runways, navaids, and the idle and performance factors are displayed.

The A/C STATUS page is displayed automatically when the FMGC is initially selected from the MCDU menu, when the FMS transitions to the DONE phase at the end of a flight or after a long-term interruption of aircraft electrical power. It may also be manually selected.

608

608

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Title

The title line displays aircraft type and model (e.g., A320-200).

ENG

The ENG field displays the engine model (e.g., CFM56-5-A1).

ACTIVE NAV DATABASE

The ACTIVE NAV DATA BASE filed displays the active database valid dates and identifier. Delta Air Lines' A319/ 320 databases begin with a "DAL2" keep note below.

Note: It is possible for maintenance to inadvertently load a database for the wrong aircraft type.

SECOND NAV DATABASE

The SECOND NAV DATA BASE field displays the valid dates and identifier of the database not selected as active. Pressing LSK 3L swaps the active and second database. Changing databases clears all flight plan data, weight, and FMGC position data from the FMGC memory. Therefore this must be accomplished before any other preflight actions are accomplished.

Caution: *The database must never be changed while airborne.*

DATA - A/C STATUS Page (continued)

CHG CODE

The CHG CODE is a required entry prior to modification of IDLE/PERF values are allowed. The change code for Delta A319/320 aircraft is ARM and can only be entered on the ground with engines shut down. The data field disappears after engine start.

IDLE PERF

The IDLE / PERF field displays the current idle and performance factors.

The IDLE factor is a positive or negative number that modifies the actual idle thrust used during managed descent (when DES is displayed), and will adjust the descent predictions accordingly. Positive numbers result in a higher idle, an earlier top of descent point, and a shallower path. Normally, the IDLE factor should be left at the default setting.

The PERF factor is a positive or negative number used to correct the predicted fuel flow for the individual airframe within the FMS. The pilot can modify the performance factor as appropriate from flight planning data.

A positive performance factor indicates that the aircraft burns more fuel than a more efficient aircraft. For example, a performance factor of +5.0 indicates that this aircraft burns 5.0% more fuel than the fuel flows in the aircraft performance database. A negative performance factor indicates that the aircraft burns less fuel than the fuel flows in the performance database.

The PERF factor should equal the corresponding value on the company supplied flight plan.

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The previously entered performance factor remains until modified. It is not cleared at the FMS DONE phase and a value between +10.0 and -10.0 can be entered.

To modify either value, the CHG CODE must first be entered, (ARM). Manually entered values are displayed in a large font. Database values are displayed in a small font.

PILOT STORED RTES, RWYS WPTS, NAVS

The PILOT STORED RTES, WPTS, RWYS, and NAVS fields display the number of manually stored routes (RTES), waypoints (WPTS), runways (RWYS), and navaids (NAVS). These listed items are called “flight plan elements.” All of these stored items are deleted if the database is swapped or loaded.

DELETE ALL

This DELETE ALL prompt deletes all manually stored elements, except those that are part of the active or secondary flight plans. If any pilot stored elements are retained in the active or secondary flight plan, a MCDU F.PLN ELEMENT RETAINED message is displayed in the scratchpad when DELETE ALL is selected.

DATA - A/C STATUS Page (continued)

SOFTWARE STATUS/ XLOAD

The SOFTWARE STATUS/ XLOAD prompt displays the P/N XLOAD page. This page provides information about software version (Part Number - P/N) as well as a cross load function that allows databases to be loaded from the off-side FMS. Information is displayed for several files including:

- FMS Software Version
- NAV Database (also presented on active database)
- Flight Management Airline options
- Flight Management Options
- Performance Database

The software loads are modified as needed by maintenance. This data is available for pilot review but requires no pilot action.

The P/N XLOAD page displays FMS1/FMS2 IDENTICAL when there is no difference between part numbers (software versions) on each FMGC, and START XLOAD when a difference is detected.

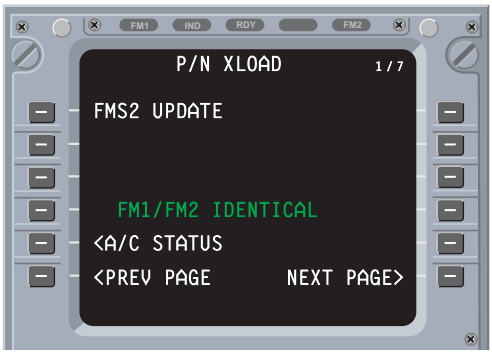
If a crossload is in progress, the time remaining until completion is displayed.

DATA - A/C STATUS Page - P/N XLOAD

General

The P/N XLOAD (Part Number Crossload) page allows the crossloading of a database or the FMGC configuration files when they are different on each side. This is not normally a pilot function.

Crossloading from this page avoids reviewing each individual P/N STATUS page.



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FMS 1 UPDATE
FMS 2 UPDATE

FMS 1 UPDATE is displayed when the FMS 1 data can be loaded into the right side FMGC. FMS 2 UPDATE is displayed when the FMS 2 data can be loaded into the left side FMGC.

FMS1/FMS2 IDENTICAL

FMS1/FMS 2 IDENTICAL is displayed when there is no difference between both sides.

START XLOAD

The START XLOAD prompt replaces the FMS1/FMS 2 IDENTICAL message in line 4 only if a difference is detected between the two FMSs. FMS1 TO FMS2 or FMS2 TO FMS1 will be displayed depending on which MCDU is used to access the page. Selecting the prompt initiates the crossload of all database and configuration files as indicated.

Caution: *The MCDU corresponding to the FMGC with the most up to date database must be used to initiate the crossload.*

A/C STATUS

The A/C STATUS prompt displays the A/C STATUS page. The prompt is only displayed if no crossload is in progress.

MN REMAINING

If a crossload is in progress, the time remaining until completion of the crossload is displayed in minutes and seconds. A crossload takes approximately 20 minutes to accomplish.

PREV PAGE

The PREV PAGE prompt displays the A/C STAUS page.

NEXT PAGE

The NEXT PAGE prompt displays the next P/N XLOAD page.

DATA - A/C STATUS Page - P/N XLOAD (continued)

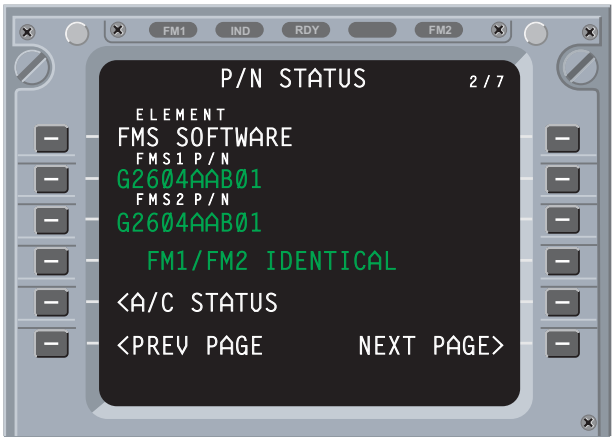
P/N STATUS Pages

The P/N STATUS (Part Number Status) pages are selected as pages 1-7 from the P/N XLOAD page via the NEXT PAGE prompt. These pages allow reviewing and crossloading individual databases and configuration files between each FMS.

The P/N STATUS pages correspond to the following databases:

- Page 2 - FMS software (FMS SOFTWARE)
- Page 3 - NAV database (NAV DATA BASE)
- Page 4 - FM airline configuration file (FM AIRLINE OPTION)
- Page 5 - FM options configuration file (FM OPTIONS CONFIG)
- Page 6 - Performance database (PERF DATA BASE)
- Page 7 - Magnetic variation database (MAG VAR DATA BASE)

Page 3 is displayed in the following example



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7/05 F340354C

7/05 F340355C

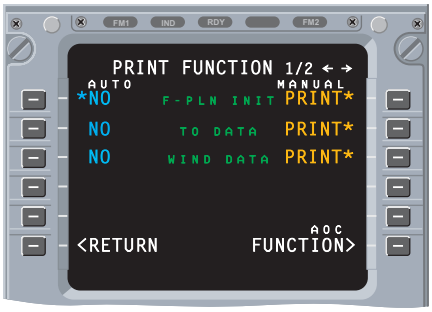
7/05 F340356C

7/05 F340357C

DATA - A/C STATUS Page - PRINT FUNCTION pages

General

The PRINT FUNCTION pages allow the printing of various reports related to the current flight.



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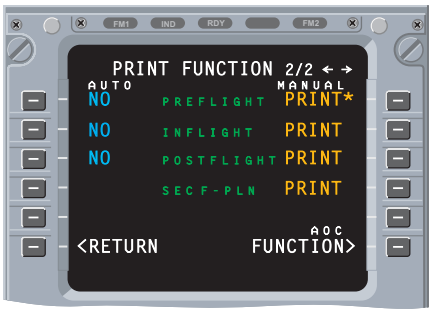

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AUTO

The AUTO prompt displays YES or NO if the corresponding report will be printed automatically. All the reports have NO as the default setting.

Prompts displayed with a star allow the YES or NO state to be changed. Blank fields or NO prompts displayed without a star cannot be enabled for automatic printing.

PRINT *

The PRINT prompt selects manual printing of the report.

If a PRINT prompt is displayed without a star, the report cannot be printed.

When the prompt is selected, the star is removed until the report printing is complete.

Availability of manual print reports depends on FMGC flight phase as summarized in the table below:

PHASES / REPORTS	PREFLIGHT	TAKE-OFF	CLIMB	CRUISE	DESCENT	APPROACH	GO AROUND	DONE
F-PLN INIT	X							
TO DATA	X	X						
WIND DATA	X	X	X	X	X	X	X(2)	
PREFLIGHT	X							
INFLIGHT		X	X	X	X	X	X	
POSTFLIGHT	(1)							X
SEC F-PLN	X	X	X	X	X	X	X	

(1) POST-FLIGHT report remains printable until INIT page FROM/TO [1R] is completed.

(2) If destination data modified.

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DATA - A/C STATUS Page - PRINT FUNCTION pages (continued)

F-PLN INIT

The F-PLN INIT prompt prints the flight plan initialization data, which includes, the route, performance factors, cruise altitude and temperature, tropopause altitude, cost index, and fuel data.

TO DATA

The TO DATA prompt prints the takeoff data associated with the takeoff performance page.

WIND DATA

The WIND DATA prompt prints the wind data report, which includes all currently entered wind data in the flight plan, destination QNH, temperature, and transition altitude.

PREFLIGHT

The PREFLIGHT prompt prints the preflight report. The preflight report includes flight plan initialization data, planned cruise flight level and step climbs, selected runways, SIDS, STARS, approaches, flight plan waypoints and the available predictions for each, fuel predictions summary, and database P/N STATUS codes.

When AUTO printing is set to YES, the preflight report is automatically printed at engine start.

INFLIGHT

The INFLIGHT prompt prints the in-flight report. The in-flight report is similar to the preflight report except it also provides completed predictions for the actual weight and includes the current position and meteorological data and history values for flight plan waypoints already passed.

When AUTO printing is set to YES, the infight report is automatically printed at takeoff.

POSTFLIGHT

The POSTFLIGHT prompt prints the postflight report. The postflight report is similar in content to the preflight report and in-flight reports, but all data is derived from flight plan history data.

When AUTO printing is set to YES, the postflight report is automatically printed at engine shutdown.

SEC F-PLN

The SEC F-PLN prompt prints the SEC F-PLN report. The secondary flight plan report is similar to the in-flight report except it is for the secondary flight plan.

RETURN

The RETURN prompt returns the display to the DATA INDEX page.

DATA - A/C STATUS Page - AOC FUNCTION pages

General

The AOC function pages are designed to request the flight plan, takeoff data, or wind data from the SOC. In addition, it has the capability to automatically send flight plan and position reports.

At the present time, these functions are unavailable.

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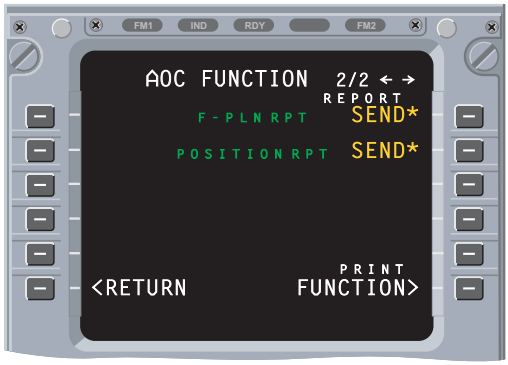

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DATA - CLOSEST AIRPORTS

General

The CLOSEST AIRPORTS function provides indication of the four closest airports from PPOS. Enables selection of a fifth airport.

Accessing the CLOSEST AIRPORTS page is by selecting DATA then CLOSEST AIRPORTS at LSK5L. This displays page 1.

The four closest airports are displayed by order of distance from PPOS.

BRG/DIST/UTC information are provided for each. These airports may also be visualized on the ND with the ARPT key on the EFIS control panel.

Page 2 is displayed by selecting the EFOB/WIND prompt at LSK6R. The EFOB and headwind/ tailwind information are provided.

The lists of airports depends on the airports listed in the A/C database.

Note: The BRG/ DIST/ UTC/ EFOB information is only available when in the CRZ phase of flight.

Airport Pilot Selection

In page 1, field 5L, the pilot may enter a fifth airport.

At any time field 5L may be overwritten, or cleared (in this case the field reverts to the blue brackets).

The selected airport remains in 5L when selecting CLOSEST AIRPORTS page 2.

BRG

The BRG displays the magnetic bearing from PPOS to the listed airport.

DIST

The DIST displayed is in NM from PPOS to the listed airport.

DATA - CLOSEST AIRPORTS (continued)

UTC or TIME

Time is determined from distance and computed ground speed. Cruise ground speed is based on optimal Mach or selected Mach/Speed, and effective wind (entered on the CLOSEST AIRPORTS page 2 or computed.

Descent ground speed is based on a descent minimum fuel speed (cost index CI=0) and a wind interpolated from cruise flight level to zero ground speed.

- The label is UTC if F-PLN contains a time origin, value shown is ETA at each listed airport.
- The label is TIME if F-PLN does not contain a time origin, value is predicted flight time.
- The field is dashed when time cannot be computed due to ADIRS parameters invalidity or when predictions are not available. Predictions are only available in CRZ phase of flight.

FREEZE or UNFREEZE

The prompt at 6L allows to freeze or unfreeze the list of four closest airports.

While the list is frozen

- Data for these airports continue to be computed and displayed
- Pilot may still select/overwrite airport in 5L.

When UNFREEZE is selected, the list of four closest airports and data are updated.

EFOB/WIND

When page 2 is displayed, the list of four closest airports is automatically frozen, as written in line 6; associated EFOB and EFF WIND continue to be updated. The pilot entered airport in line 5 may be modified

The EFOB at each airport is computed only when the A/C is in the CRZ phase. EFOB is dashed in all other phases.

The EFOB is computed as follows.

- Cruise fuel burn based on current fuel flow corrected for GW and EFF WIND,
- Descent fuel burn from CRZ ALT to DEST ALT based on cost index.
- Predictions only available in CRZ phase of flight.

EFF WIND

This is the anticipated headwind or tailwind along a direct track to the airport. The wind field reflects active wind value used by the FMS to estimated ground speed. Default value is displayed in small font. It may be overwritten by the pilot and then will be in large font.

A wind entry is proceeded by

- “+”, T OR TL for a tailwind
- “-”, H, or HD for a headwind.

You cannot clear the default wind value, you can only overwrite the value.

EQUI-TIME POINT

General

The EQUI-TIME POINT(ETP) is a pseudo-waypoint in the lateral flight plan from which the times to reach two designated reference points are equal.

Accessing the EQUI-TIME POINT page is by selecting DATA then the EQUI-TIME POINT prompt at 6L.

By default, the reference points 1 and 2 are the DEPT and DEST airports respectively. However, they may be overwritten.

Lines 1 and 3 display BRG, DIST, and UTC (ETA) from PPOS to respective reference waypoints.

Lines 2 and 4 display BRG, DIST, and UTC **from ETP** to reference points.

ETP location along the flight path is displayed on line 5, referenced to the ACTIVE F-PLN WPT following the ETP. In the example to the right, the ETP is located 18.3nm before ONL.

Distance and ETA (UTC) along the flight path from PPOS to ETP are displayed in line 6.

On the ND, the ETP is shown as a green circle with ETP next to it.

The flight plan does not show the ETP.

EQUI-TIME POINT

Entering wind data

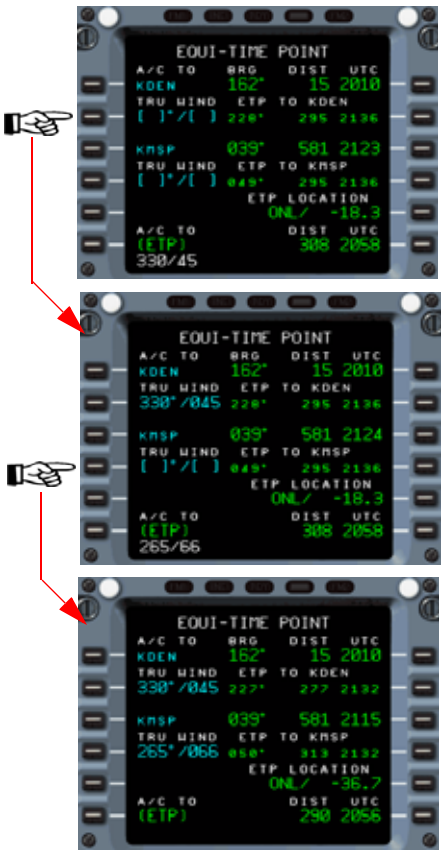
Default wind is zero at the reference points. Pilots may enter true wind at the reference points, **at CRZ FL**.

Forecast winds are not used for ETP computations.

During ETP computations the page re-displays the information which can take up to 3-4 seconds.

A new ETP is displayed whenever F-PLN is changed, or if computed times change by more than 3 minutes.

Entered winds may be modified by overwriting TRU WIND values or by clearing the field with the CLR key.

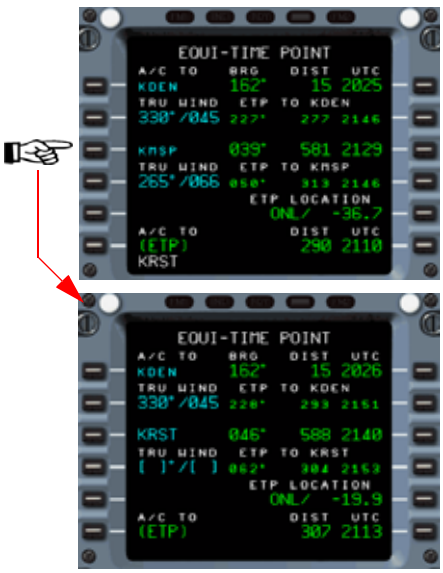


Changing reference point

Any WPT, Navaid, NDB, Airport, RWY or pilot defined element can be used as a reference point.

When a reference point is changed, the associated TRU WIND reverts to zero, brackets are displayed.

Depending on entered reference point, an ETP may not exist. In this case NO ETP is shown at 6L.



DATA - WAYPOINT Page

General

The WAYPOINT page displays the latitude/longitude of the selected database waypoint. Entering the identifier of the waypoint at 1L causes the latitude/longitude of the waypoint to be displayed.

If a waypoint name entered into the IDENT field is not in the database, the NEW WAYPOINT page is automatically displayed.

IDENT

The IDENT field displays the identifier of the selected waypoint.

LAT/LONG

The (LAT/LONG) field displays the latitude/longitude of the selected waypoint.

DATA - NAVAID Page

General

The NAVAID page displays the information stored in the database about a specified navaid.

If the pilot enters a navaid name not in the database into the ident field, the NEW NAVAID page is automatically displayed

Example of VORTAC

Example of ILS-DME

IDENT

The identifier of the selected navaid is displayed. An identifier for a different navaid can be entered in this field if desired.

CLASS

The class of the navaid is displayed. The navaid class can be one of the following: VOR, DME, VORDME, VORTAC, NDB, LOC, ILSDME, or ILS.

LAT/LONG

The latitude/longitude (LAT/LONG) of the navaid is displayed.

FREQ

The frequency (FREQ) of the navaid is displayed.

ELV

The elevation (ELV) of the navaid is displayed.

DATA - NAVAID Page (continued)

FIG OF MERIT

The Figure of Merit (FIG OF MERIT) appropriate for the navaid class is displayed. The FMGC does not use the navaid for navigation purposes at ranges greater than the figure of merit. The range (in nautical miles) corresponding to the figure of merit is depicted in parenthesis.

The figure of merit corresponds to the ranges in the following table:

Fig of Merit	Range
0	up to 40 nm
1	up to 70 nm
2	up to 130 nm
3	up to 250 nm

RWY IDENT

The RWY IDENT field displays the runway associated with the navaid. This field is displayed if the reference navaid is an ILS or LOC type facility.

STATION DEC

The STATION DEC (Station Declination) is displayed if a VOR, VOR/DME, or VORTAC station is referenced. The station's magnetic declination is entered or displayed.

The terms "variation" and "declination" are generally synonymous. In this case the declination value refers to the station's north orientation. It is not necessarily in exact agreement with the current local magnetic variation value, as the local magnetic variation figure varies over time and the stations declination value is fixed.

CATEGORY

The CATEGORY field displays the category (1, 2, or 3) of the ILS. A LOC/DME has a category of 0. The field is displayed if the reference navaid is an ILS.

COURSE

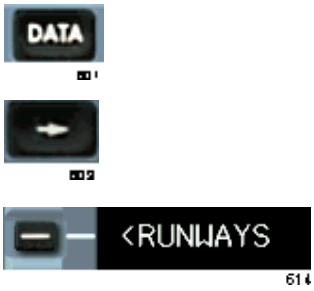
The COURSE field displays the final approach course associated with an ILS or localizer.

DATA - RUNWAY Page

General

The RUNWAY page displays information stored in the database about a selected runway. Entering the identifier of the runway at 1L displays the runway information. The runway identifier must be the airport identifier followed by the runway identifier (e.g., KMSP30L).

If the runway is not in the database, the NEW RUNWAY page is automatically displayed. This would be used to insert a non-database airport into the FMGC.



IDENT

The IDENT field displays identifier of the runway. For parallel runways, an R, C, or L character is required (e.g., KDTW21C).

LAT/LONG

The LAT/LONG field displays the latitude/longitude of the runway's threshold.

LENGTH

The LENGTH filed displays the runway length.

ELV

The ELV field displays the runway's touchdown zone elevation.

CRS

The CRS field displays the runway's magnetic course.

ILS IDENT

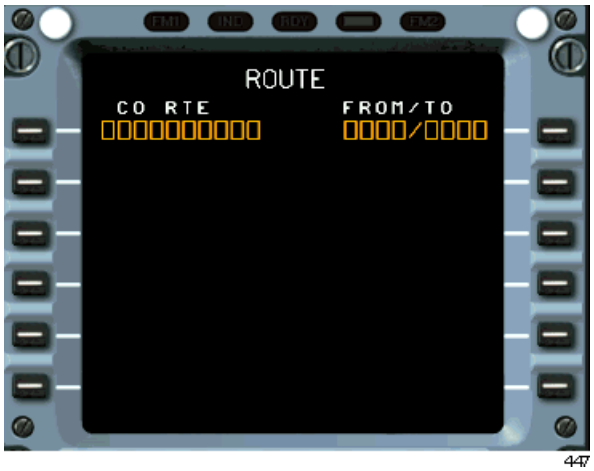
The ILS IDENT field displays the identifier of the associated ILS (if applicable).

DATA - ROUTE Page

General

The ROUTE page displays database routes stored between two airports. The route can be accessed by entering the Company Route (CO RTE) ident (e.g., MSPLGA) or the city pair (FROM/TO) (e.g., KMSP/KLGA).

If the route is not in the database, a NOT IN DATABASE scratchpad message is displayed.



If multiple routes are stored between a specified city pair, the route displayed is numbered in the title line.

Delta databases do not currently include company routes.

CO RTE

The CO RTE FIELD displays the company route identifier.

FROM/TO

The FROM/TO field displays the city pair associated with the route.

Route Description

The database route is displayed with waypoints in green and routing in white. The only waypoints displayed are those at which the routing changes. Therefore, all of the waypoints on a particular airway between two points are not displayed.

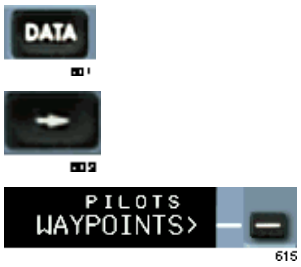
DATA - PILOT WAYPOINTS Page

General

The STORED WAYPOINT pages display manually entered waypoints and allows access to the NEW WAYPOINT page. Each STORED WAYPOINT page displays one waypoint. The pages are displayed in the order in which the waypoints were created.

Up to 20 waypoints may be stored; latitude/longitude crossing, abeam, and radial intercept points are not included in the stored waypoint list.

If no waypoints have been stored, the NEW WAYPOINT page is automatically displayed.



If multiple waypoints have been stored, the waypoint displayed is numbered in the title line. In the example above, the waypoint displayed is number 1 of 2 (1/2). When multiple waypoints are available, the ← → arrows are displayed in the upper right corner. The other waypoints are accessed by using the page keys.

IDENT

The IDENT field displays the selected waypoint name. To delete the waypoint, clear the field with the CLR key.

LAT/LONG

The LAT LONG field displays the waypoint's latitude/longitude (LAT/LONG).

Definition

If the waypoint was created with a PLACE/BEARING/DISTANCE or PLACE-BEARING / PLACE-BEARING definition, the appropriate title and definition is displayed.

NEW WAYPOINT

The NEW WAYPOINT prompt displays the NEW WAYPOINT page, where a new waypoint can be created by entering the appropriate data and storing the information.

DELETE ALL

The DELETE ALL prompt deletes all stored, manually created waypoints, except those currently in use in the active or secondary flight plans.

When selected, the DELETE ALL prompt changes to CONFIRM DELETE ALL. That prompt must be selected for the waypoints to be deleted.

If some waypoints are in use (e.g., in a flight plan), they are not deleted and a F-PLN ELEMENT RETAINED message is displayed in the scratchpad.

DATA - PILOTS WAYPOINTS - NEW WAYPOINT Page

General

The NEW WAYPOINT page can be displayed manually or automatically. The page can be used to create and store up to 20 waypoints.

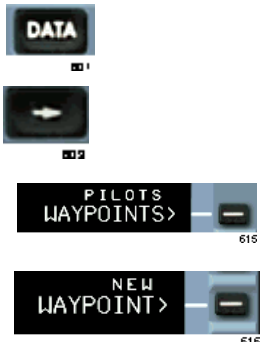
The NEW WAYPOINT page enables the crew to create a non-database waypoint in one of three different ways.

The page is displayed automatically if a waypoint identifier is entered into the flight plan that is neither stored nor in the active database.

The page can be displayed manually by selecting the NEW WAYPOINT prompt on the PILOTS WAYPOINT page.

The waypoint IDENT and one of the three possible definition fields are required entries (LAT/LONG, place/bearing/distance, or place-bearing/place-bearing).

Only 20 pilot created waypoints are allowed, if there is an attempt to make a 21st pilot stored waypoint the following message is displayed, LIST OF 20 IN USE. To create a new waypoint, one of the 20 currently stored waypoints must be deleted. A specific pilot entered waypoint can be cleared by selecting the corresponding STORED WAYPOINT page, and entering CLR at LSK 1L.



IDENT

The IDENT field displays the waypoint name. If the name is not already displayed, a new waypoint name must be entered. The name may be one to seven characters long and can be any combination of alpha-numeric characters.

LAT/LONG

A LAT/LONG waypoint (LL), is created by entering the latitude and then longitude of the new waypoint into the scratchpad, along with N/S and E/W characters as appropriate. The N/S and E/W characters can precede or follow the numbers. A “/” is required between the LAT and LONG entries. The waypoint is then inserted into the flight plan at the desired location.

Care should be used to ensure that the correct number of characters are entered. Leading zeros are not required. However, if less than four digits are entered (e.g., N47 / W118), the waypoint is entered incorrectly as minutes instead of degrees. Up to one decimal place may be entered. Examples of correct entries are:

- N4732/W11803
- N4732.5/W11803.6
- 4732N/11803W
- 4732.5N/11803.6W
- 4732.5N/W11803.6

DATA - PILOTS WAYPOINTS - NEW WAYPOINT Page (continued)

PLACE / BRG / DIST

The PLACE / BRG / DIST field (PBD), allows the waypoint to be defined by a PBD definition. The FMS computes the waypoints latitude/longitude from this entry.

The PBD waypoint is created by:

- Entering the ident of the place (this can be any database fix, including a navaid, runway, waypoint, or pilot-created waypoint), a “/,” then
- Entering the magnetic bearing from the place, a “/,” and then
- Entering the distance in nautical miles

Examples of correct entries are:

- MSP/330/75
- IMSP/176/14.2
- NARCO/194/52
- LEN01/245/72
- PBD03/005/15

PLACE - BRG / PLACE - BRG

The PLACE - BRG / PLACE - BRG (PBX) field allows the waypoint to be defined by a PBX definition. The FMS computes the waypoint’s latitude and longitude from this entry.

The points can be any database points (navaids, waypoints, runways, etc). For example, this allows the pilot to create a waypoint at the intersection of two airways by using radials off of two points.

The PBX waypoint is created by:

- Entering the ident of the place (this can be any database fix including a navaid, runway, waypoint, or pilot-created waypoint), a “-,” then
- Entering the magnetic bearing from the place, a “/,” and then
- Entering the ident of the second place, a “-,” and then
- The bearing from the second place

The two bearings must cross or a NO INTERSECTION FOUND scratchpad message will be displayed. The “-” and “/” symbols must also be in the proper locations or a FORMAT ERROR message will be displayed.

Examples of correct entries are:

- GEP-180/FGT-270
- IMSP-110/MKT-090
- LISA1-360/GEP-270

RETURN

The RETURN prompt returns the display to the previous page.

STORE

The STORE prompt is displayed when the waypoint name and one definition field has been complete. When the prompt is selected, the waypoint is stored in the database.

DATA - PILOTS WAYPOINTS - NEW WAYPOINT Page (continued)

Flight Plan Entry

Entering waypoints into the flight plan can be accomplished on either the active or secondary flight plan. A waypoint entered into the flight plan is automatically stored.

Each pilot-created waypoint entered into the flight plan is identified by the type of entry and then the sequence number. For example, if the pilot creates a LL, then a PBD, and then a PBX, they would be automatically stored and identified as LL01, PBD02, and PBX03, respectively.

Example below.

DATA - PILOTS NAVAIDS Page

General

If no navaids have been stored, the NEW NAVAID page is displayed when the PILOTS NAVAIDS prompt is selected.

The NEW NAVAIDS page allows the pilot to store up to 20 navaids in the database. If 20 navaids have been stored, attempting to create another displays the ‘LIST OF 20 IN USE” scratchpad message. to create a new NAVAID, one of the 20 currently stored NAVAIDS must be deleted.

A specific pilot-entered navaid can be cleared by selecting the corresponding STORED NAVAID page, and entering CLR at LSK 1L.

The NEW NAVAID page is automatically displayed when:

- An unknown identifier is entered on the NAVAID page.
- If the PILOTS NAVAIDS page is selected with no existing stored navaids.
- If a new ILS is identified while storing a new runway on the NEW RUNWAY page.
- An unknown identifier is entered on the radio navigation (RAD NAV) page.

The NEW NAVAID page can also be selected by the pilot from the STORED NAVAID page.

The STORED NAVAID page is identical to the NEW NAVAID page with two exceptions:

- A NEW NAVAID prompt is displayed
- A DELETE ALL prompt is displayed

IDENT

The IDENT field is used it identify the new selected navaid.

DATA - PILOTS NAVAIDS Page (continued)

CLASS

The CLASS field identifies the new navaid into one of six classes:

- VOR
- VORDME
- VORTAC
- NDB
- LOC
- ILS

Once the class of navaid is inserted, the NEW NAVAID page changes to the following NEW NAVAID page.

OR

LAT / LONG

The LAT / LONG field is for entering the navaid's latitude/longitude.

FREQ

The FREQ field is for entering the navaids frequency.

DATA - PILOTS NAVAIDS Page (continued)

ELV

The ELV prompt is for entering the navaid's elevation.

FIG OF MERIT

The figure of merit defines the maximum usable range in nautical miles for navigation. The figure of merit corresponds to the ranges in the following table:

Fig of Merit	Range
0	up to 40 nm
1	up to 70 nm
2	up to 130 nm
3	up to 250 nm

If no figure of merit is entered, 2 is used as a default value.

STATION DEC or RUNWAY IDENT

This prompt is for entering the magnetic variation (STATION DEC) of the navaid. For example, 02E indicates 2 degrees East variation. If the class of the navaid is an ILS, the prompt is labeled RUNWAY IDENT, and the corresponding runway ident (e.g., 24L) is entered.

CATEGORY

When the new navaid is an ILS or LOC, the category of the ILS (1, 2, or 3) is required.

COURSE

When the new navaid is an ILS, the final approach course (in degrees) is required.

RETURN

This prompt selects the previous MCDU page (either PILOT NAVAID or DATA INDEX).

STORE

This prompt is displayed when all required data entries are made. When pressed, the navaid is added to the database and used for navigation.

Note: Leaving this page without selecting this prompt deletes all entered data.

DATA - PILOT RUNWAYS Page

General

If no runways have been stored, the NEW RUNWAY page is displayed when the PILOTS RUNWAYS prompt is selected.

The NEW RUNWAYS page allows the pilot to store up to 10 runways in the database. If 10 runways have been stored, attempting to create another displays the 'LIST OF 10 IN USE" scratchpad message. To create a new RUNWAY, one of the 10 currently stored RUNWAYS must be deleted.

A specific pilot entered runway can be cleared by selecting the corresponding STORED RUNWAY page, and entering CLR at LSK 1L.

The NEW RUNWAY page is automatically displayed when:

- An unknown identifier is entered on the RUNWAY page.
- If the PILOTS RUNWAYS page is selected with no existing stored runways.
- If a new runway is identified while storing a new ILS or LOC on the NEW NAVAID page.
- Either the departure or destination airport is not in the database when entered on INIT page A.

The NEW RUNWAY page can also be manually selected by the pilot from the STORED RUNWAY page.

If multiple runways have been stored, the runway displayed is numbered in the title line.

The STORED RUNWAY page is identical to the NEW RUNWAY page with two exceptions:

- A NEW RUNWAY prompt is displayed
- A DELETE ALL prompt is displayed

NEW RUNWAY

This prompt selects the NEW RUNWAY page.

DATA - PILOTS RUNWAYS Page (continued)

IDENT	An ident for the new runway is entered in this field. The ident must be a standard ICAO ident. The ident should be entered as follows: the four letter airport ident (e.g., KEDW), followed by the runway heading and L, C, or R, (Left, Center, or Right) as appropriate. For example, KEDW22L.
LAT/LONG	The latitude/longitude of the runway touchdown zone is entered in this field.
LENGTH	The usable length of the runway (in feet) is entered in this field.
ELV	The elevation of the runway touchdown zone (in feet, MSL) is entered in this field.
CRS	The magnetic heading of the runway is entered in this field.
ILS IDENT	The ILS ident associated with the runway (if applicable) is entered in this field. If the ILS is not in the database, the NEW NAVAID page is automatically displayed.
RETURN	This prompt selects the previous MCDU page (either STORED RUNWAY or DATA INDEX).
STORE	This prompt is displayed when all required data entries are made. When pressed, the runway is added to the database and can be used for navigation. **Note:** Leaving this page without selecting this prompt deletes all entered data.

DATA - PILOTS ROUTES Page

General

The PILOTS ROUTES prompt displays the NEW ROUTE page. This page is used for inserting a stored route into the database.

The NEW ROUTE page enables the crew to copy a route from the active flight plan and/or secondary flight plan and store it as a PILOTS ROUTE. The stored route may be recalled later and used on the INIT A page to define a route.

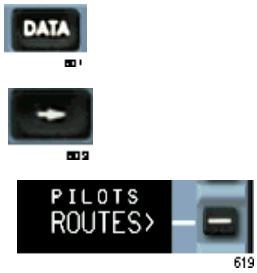
Up to 5 routes may be defined. If 5 routes have been stored, attempting to create another displays the STORED ROUTE FULL scratchpad message. To store a new pilot ROUTE, one of the 5 stored ROUTES must be deleted.

The pilot creates the route to be stored on either the active flight plan page (during preflight only), or by modifying the secondary flight plan. This flight plan is then stored as a new route by selecting either 2L or 3L as appropriate.

Pilot-entered flight plan constraints, holding patterns, offsets, and arrivals are not stored. A REVISIONS NOT STORED scratchpad message is displayed.

The NEW ROUTE page is automatically displayed when:

- An unknown route identifier is entered on the INIT A or STORED ROUTES pages.
- The STORED ROUTES prompt is selected on the DATA INDEX page with no existing stored routes.
- This page can be manually selected from the STORED ROUTES page or the DATA INDEX page.



CO RTE

The route can be named by the pilot with up to seven characters. If not named, the route is saved as SRTE1, SRTE 2, or SRTE 3, as appropriate.

STORE ACTIVE F-PLN

The STORE ACTIVE F-PLN prompt stores the contents of the active flight plan as a new route.

The prompt is only displayed during preflight when the FROM/TO field is filled in on INIT page A.

STORE SECONDARY F-PLN

The STORE SECONDARY F-PLN prompt stores the contents of the secondary flight plan as a route.
The prompt is only displayed during preflight when the FROM/TO field is filled in on INIT page A and no waypoints on the secondary flight plan have been sequenced.

Intentionally Left Blank

Initial Pages

INIT PAGE A

General

The Initial (INIT) pages allow the pilot to enter preflight data, including the departure, destination, and alternate airports, winds, and fuel planning data.

The flight plan is initialized on INIT page A. The departure and destination airports are entered together, or a Company Route (CO RTE) is selected. This entry is required before other flight plan routing data can be entered.

INIT page A can be accessed at any time. However, after takeoff, it's use is limited to display information only. INIT page B (discussed later) can be accessed from this page by using the NEXT PAGE arrow key → If INIT B is accessed after the TAKEOFF Phase, this will bring up the Fuel Prediction Page.

The first entry is normally the FROM/TO or CO RTE. This entry results in the display of latitude/longitude data on the IRS INIT page. When an entry is made at either LSK 1L or LSK 1R, the FMS active database date and aircraft clock date are compared. If there is a difference, a CHECK DATA BASE CYCLE scratchpad message is displayed.

CO RTE

Delta does not maintain any stored company routes. Once the FROM/TO airports are entered by the pilot, the CO RTE field displays NONE. Once a flight plan has been inserted by the pilot, the CO RTE field is blank.

ALTN/ CO RTE

The ALTN/ CO RTE (Alternate Company Route) field displays and allows entry of an alternate airport and the company route identifier between the destination and alternate airport. This field is dashed until a primary destination is entered.

The alternate (and route, if available) is automatically entered into the flight plan following the destination airport. If a routing is not specified to the alternate, a direct routing between the destination and alternate is assumed.

If an alternate has been entered and then is not desired, the ALTN field may be changed to NONE by selecting the NO ALTN prompt on the ALTERNATES page.

Caution: *Entering an alternate into the flight plan subtracts the calculated fuel burn for the alternate flight plan (from the destination to the alternate) from the calculated "EXTRA" fuel. If an alternate is entered into this field, the alternate fuel must not be entered in the "FINAL" field, or a double subtraction of the alternate fuel will occur.*

INIT Page A (continued)

FLT NBR

The flight number is entered in this field. It can be any alphanumeric sequence of up to 8 characters. An example of DAL's standard entry is:

- DAL123

This information is sent to various applications, e.g., ATSU, ACARS, DFDR; it therefore should reflect the actual flight number (with DAL before) on the flight release.

After an entry is made, the flight number is also displayed on the PROG and F-PLN pages.

COST INDEX

The Cost Index (CI) is entered in this field.

The cost index can also be modified on some of the performance pages.

If the cost index is not entered before the aircraft weight data is entered (e.g., the zero fuel weight (ZFW) on INIT page B or the gross weight on the FUEL PRED page), it will default to the cost index used for the previous flight and a USING COST INDEX XX scratchpad message is displayed.

CRZ FL/ TEMP

The planned initial cruise altitude (CRZ FL) and temperature (TEMP) are inserted in this field. It is limited to FL 390. If only three digits are entered (e.g., 370), a flight level is assumed. If the cruise altitude will be an MSL altitude, a five-digit entry should be made (e.g., "10000").

After entry, the CRZ FL is displayed on the PROG page.

If only the CRZ FL is entered, then the standard ICAO temperature for that altitude is automatically displayed. If there is a significant difference between the actual and standard temperature, the forecast temperature at altitude should be entered. Any difference between standard atmospheric temperature and the forecast temperature is then applied to performance calculations (for example, REC MAX altitude).

The pilot can modify the temperature with a single entry after entering the cruise FL. (e.g., /-52. A pilot modified temperature is displayed in large font.

Caution: *Entering a positive number when a negative number is intended can cause significant prediction errors.*

INIT Page A (continued)

FROM/TO

The four letter ICAO identifiers for the departure and destination airports are entered in this field. Both fields must be entered together. Entries into this field must include the correct four letter ICAO prefix for the airport (e.g., Kxxx for United States, Cxxx for Canada, Mxxx for Mexico, etc.) The departure/destination airport pair is automatically entered into the flight plan.

In addition to initializing the flight plan, this entry also:

- Provides the departure and destination field elevations from the database for the pressurization system.
- Provides the departure Airport Reference Point (ARP) coordinates for the IRS alignment.
- Accesses the ROUTE SELECTION page. If stored company routes are available, the desired routing can be selected.

If company routes are not available, an entry at 1R deletes the amber boxes at 1L from the INIT page A.

If either the departure or destination airports are not in the database, the NEW Runway page is automatically displayed.

INIT REQUEST

[2R] - Enables F-PLN initialization via data link. INIT REQUEST prompt is available before engine start provided no ACTIVE or TMPY F-PLN exists.

IRS INIT>

Used to finish the alignment process for the ADIRUs.

WIND>

The WIND prompt accesses the CLIMB WIND page.

TROPO

The standard tropopause (TROPO) altitude of 36,090 feet is displayed. It can be modified up to a maximum of 39,000 feet, if desired, to improve preflight planning. A five digit entry is required in this field (e.g., a “350” entry sets the TROPO at 350 feet MSL).

GND TEMP

When a FROM/ TO is defined, GND TEMP is defaulted to standard ISA for the departure airport elevation and may be modified by the pilot.

INIT Page A - IRS INIT

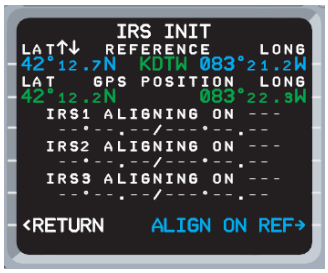
General

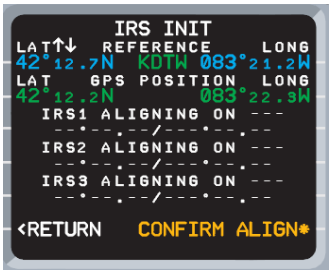
The IRS INIT page is used to finish the alignment process for the ADIRU's.

Line 1
REFERENCE

Once the FROM field on INIT A is populated, the LAT/ LONG of the departure Airport Reference Point is displayed as well as its ICAO identifier. During normal operations, there is no need to modify the latitude or longitude to match the gate coordinates or GPS position. The presentation of slew arrows adjacent to either the LAT or LONG prompts indicate that the pilot can utilize the slew keys to incrementally change the coordinates should the need arise. The slew arrows are moved between the LAT and LONG prompts by depressing LSK 1L or LSK 1R, as appropriate. The LONG cannot be incremented above 180.0 E or W, and neither the LAT nor LONG can be decremented less than 0.0 E/W or N/S.

The LAT/ LONG coordinates can also be modified individually by entering the entire latitude/ longitude coordinate in the scratchpad and pressing the appropriate LSK (1L or 1R).





Line 2
GPS POSITION

Displays current GPS position.

Lines 3/4/5

ADIRU alignment state/ source/ position.

Alignment state will indicate one of the following: OFF, ALIGNING, or ALIGNED

Alignment source will indicate REF (Hybrid ADIRU), or "---" (Autonomous ADIRU).

RETURN
LSK [6L]

Returns to INIT A to complete the FMGC initialization.

ALIGN ON REF/
CONFIRM ALIGN
LSK [6R]

Selecting these prompts enters the REFERENCE LAT/ LONG in the IRs and initiates the IRS alignment process. The ALIGN ON REF prompt reappears after CONFIRM ALIGN was pressed if the coordinates vary significantly from the previous shutdown coordinates (one or more ALIGN lights will also be flashing on the CDU). This requires the pilot to confirm the alignment coordinates by selecting the ALIGN ON REF and CONFIRM ALIGN prompts a second time.

INIT Page A - WIND

General

Wind pages for climb, cruise, and descent allow the insertion and review of winds along the flight plan route. Wind values entered in the FMS provide increased accuracy of predictions and performance calculations. Three similar wind pages are provided; CLIMB, CRUISE, and DESCENT. These wind pages allow the entry of wind for that associated phase of flight.

Winds can only be entered into the appropriate phases of prior to entering that phase, (e.g., once you've entered the cruise phase of flight, you can no longer enter cruise winds on the CRUISE WIND page).

The HISTORY wind page allows the insertion of climb phase winds that were automatically recorded during the descent from the previous flight.

Wind Entry

On each page, except the HISTORY WIND page, winds can be entered at multiple altitudes. Wind values may be uplinked, manually entered, or determined by the FMS by interpolating other wind entries.

Blue brackets are displayed when no previous entry has been made on the entry line. Uplinked and manually entered winds are displayed in large fonts, FMS computed and history winds are displayed in small font. Winds are displayed in blue when they can be modified and green when they are not modifiable. Any change in wind data will display DRAFT (yellow) on title page or UPLINK (yellow) if uplinked winds.

The format for entering wind values is DIRECTION / SPEED / ALTITUDE.

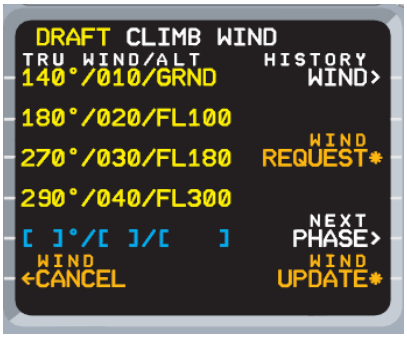
Leading zeros may be omitted within each element of the entry. The altitude value may be entered as an altitude by using four or more digits (e.g., 3000) or a flight level by using three or fewer digits (e.g., 030, 30, or FL030). For descent winds, the wind on the ground may be entered using GRND as the altitude value.

INIT Page A - WIND - CLIMB WIND

General

The CLIMB WIND page allows the entry of wind values for up to five altitudes. Once the top of climb is reached, the CLIMB WIND page is no longer available.

Uplinked and manually entered winds are displayed in large fonts, FMS interpolated winds are in small font.



Note: The CLIMB WIND page can also be accessed from the vertical revision page of the flight plan.

TRU / WIND / ALT

Up to five lines of climb winds may be entered. The wind values may be entered in any order and are automatically sorted by altitude upon entry. The climb wind data may not be modified during the climb phase.

HISTORY WIND

The HISTORY WIND prompt displays the a HISTORY WIND page. It can only be displayed during the preflight phase.

NEXT PHASE

The NEXT PHASE prompt displays the CRUISE WIND page, or the DESCENT WIND page if no cruise phase waypoints exist.

WIND UPDATE/ UPLINK INSERT

The WIND UPDATE/ UPLINK INSERT prompt inserts all the climb wind data into the flight plan calculations, and the display will automatically revert to the F-PLN page.

WIND CANCEL/ UPLINK CANCEL

The WIND CANCEL/ UPLINK CANCEL prompt will delete all the wind data from the flight plan calculations, and will revert to the F-PLN page.

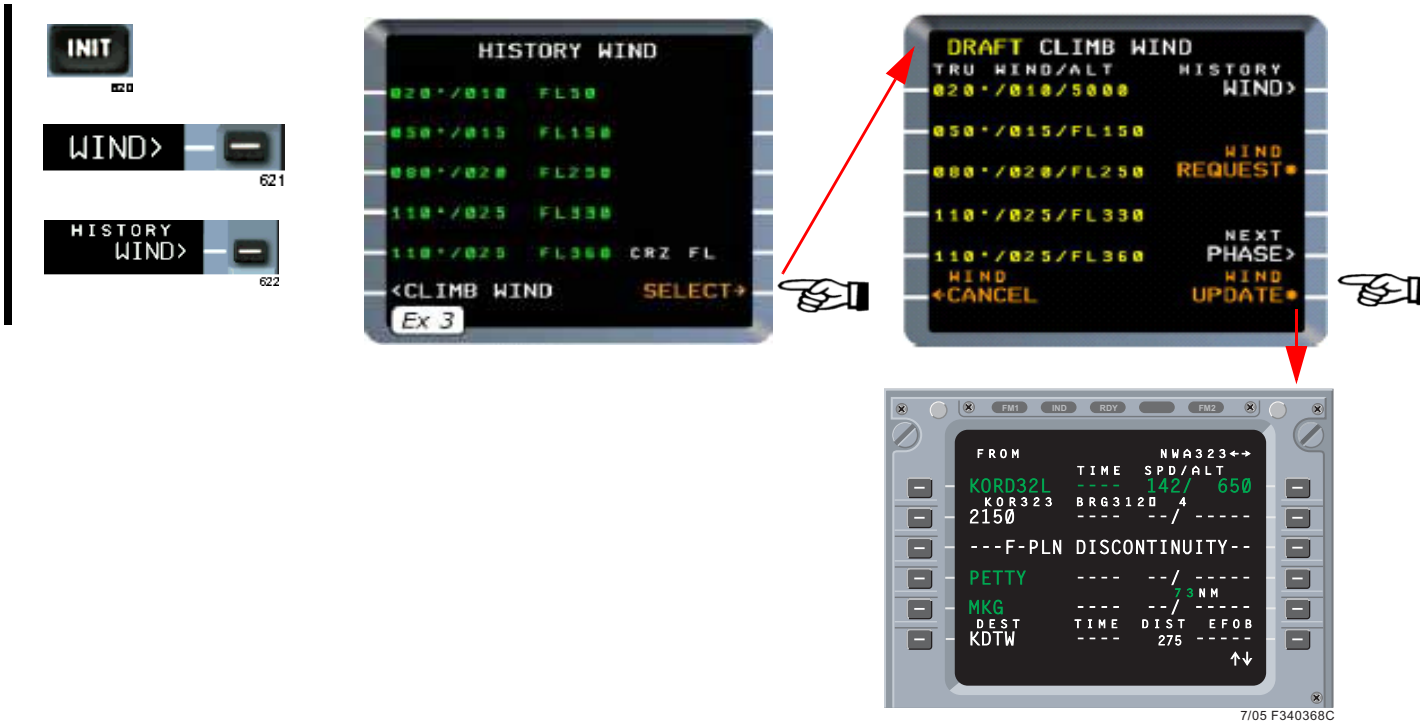
WIND REQUEST

The WIND REQUEST prompt requests winds through the AOC function, this function is used to uplink cruise winds.

INIT Page A - WIND - CLIMB WIND - HISTORY WIND

General

The HISTORY WIND page displays wind values recorded during the descent phase of the previous flight, and allows their entry into the current CLIMB WIND page. It is only available during the preflight phase. If the cruise flight level has been entered on INIT A and the winds for the current cruise altitude are available, it is noted with the CRZ FL label.



CLIMB WIND

The CLIMB WIND prompt returns the display to the CLIMB WIND page.

SELECT

The INSERT prompt inserts the history wind values into the CLIMB WIND page.

WIND UPDATE

The WIND UPDATE prompt inserts all the climb wind data into the flight plan calculations, and the display will automatically revert to the F-PLN page.

WIND UPDATE

The WIND UPDATE prompt will delete all the wind data from the flight plan calculations, and will revert to the F-PLN page.

WIND REQUEST

The WIND REQUEST prompt requests winds through the AOC function, this function can be used to uplink climb, cruise, and descent winds.

INIT Page A - WIND - CLIMB WIND - CRZ WIND

General

The CRZ WIND page allows wind entries at each cruise phase waypoint. The waypoints depicted on the CRZ WIND page are the waypoints between the FMS computed Top of Climb (TOC) and the Top of Descent (TOD).

TRU / WIND/ ALT

The TRU / WIND / ALT fields allow entry of up to four cruise winds at each point in the flight plan between the TOC and TOD. The wind data may be modified during the cruise phase.

Wind entries are automatically propagated to the downline cruise waypoints if no other wind entry exists for each waypoint and altitude.

Manually entered and uplinked winds are displayed in large font. Propagated winds values are displayed in small font. Interpolated winds are not displayed on the CRUISE WIND pages. Use the slew keys (↓↑) to scroll between other CRUISE WIND waypoints in the cruise phase.

Note: The four winds in the cruise phase must remain the same. If winds altitudes are changed throughout the F-PLN, this will result in the loss of previously entered winds in the cruise phase.

PREV PHASE

The PREV PHASE displays the CLIMB WIND page.

NEXT PHASE

The NEXT PHASE displays the DESCENT WIND page.

INIT Page A - WIND - CLIMB WIND - CRZ WIND (continued)

WIND UPDATE

The WIND UPDATE prompt inserts all the cruise wind data, or all climb, cruise and descent wind data into the flight plan calculations, and the display will automatically revert to the F-PLN page.

WIND CANCEL

The WIND CANCEL prompt will delete all the wind data from the flight plan calculations, and will revert to the F-PLN page.

WIND REQUEST

The WIND REQUEST prompt requests winds through the AOC function. When the winds are being requested the wind fields are white until the uplink is complete. Once the uplink is complete wind entries are displayed in green font (non modifiable) and UPLINK (yellow) is displayed in the title. After the WIND UPDATE prompt is selected, the wind entries change to blue font (modifiable). The cruise winds are only displayed at waypoints which will be overflown during the cruise phase of flight.

Winds may be requested throughout the flight to allow for more accurate FMGC predictions. Winds are updated in the system every 6 hours beginning at 0000Z and are available for uplink 15 to 20 minutes afterwards.

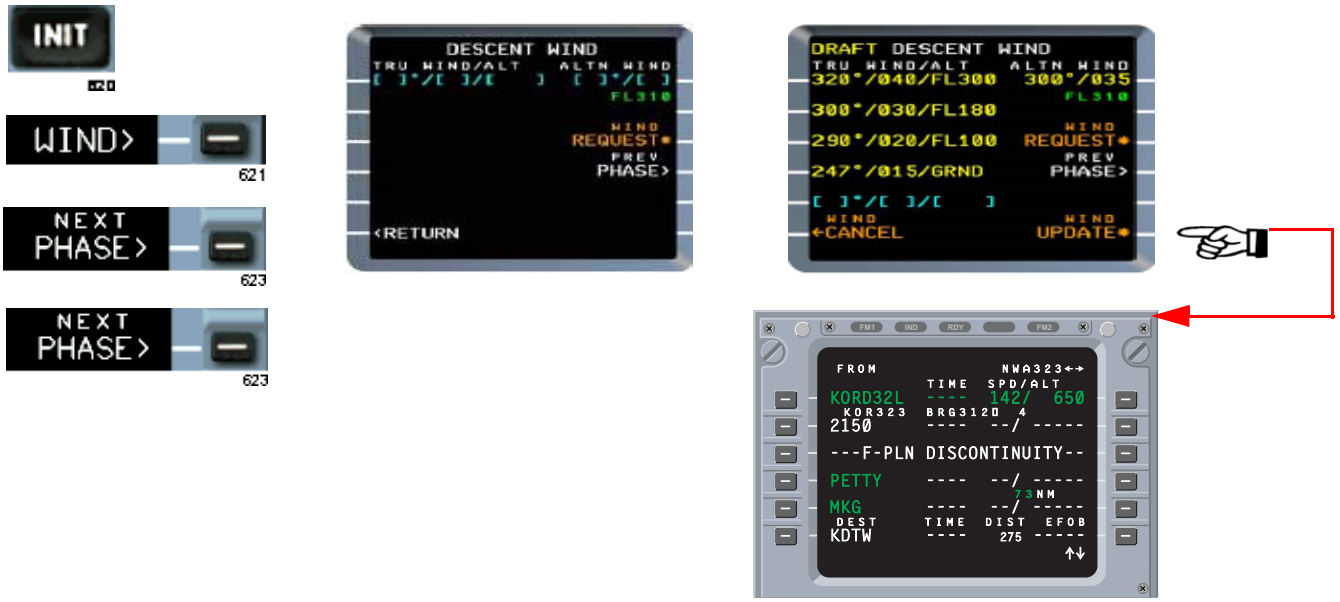
The SAT/ALT will be uplinked along with the cruise winds. The default ALT is FL330.

INIT Page A - WIND - CLIMB WIND - DESCENT WIND

General

The DESCENT WIND page allows entries for the descent phase. Wind values for up to five altitudes may be entered.

Winds entered on the DESCENT WIND page are used to display winds at waypoints on the FLIGHT PLAN page after the TOD point.



TRU / WIND/ ALT

The TRU / WIND / ALT fields allow entry of descent winds. The wind values may be entered in any order and are automatically sorted by altitude upon entry. The descent wind data cannot be modified during the descent phase.

An entry on the GRND in the ALT field, allows the entry of the wind relative to true north at ground level. This value is propagated to the PERF APPR page and corrected to a magnetic reference.

Note: These winds are critical to all descent predictions within the FMGC (e.g. descent crossing a given constraint).

PREV PHASE

The PREV PHASE displays the CLIMB WIND page.

WIND UPDATE

The WIND UPDATE prompt inserts all the descent wind data, or all climb, cruise and descent data into the flight plan calculations, and the display will automatically revert to the F-PLN page.

WIND CANCEL

The WIND CANCEL prompt will delete all the wind data from the flight plan calculations, and will revert to the F-PLN page.

WIND REQUEST

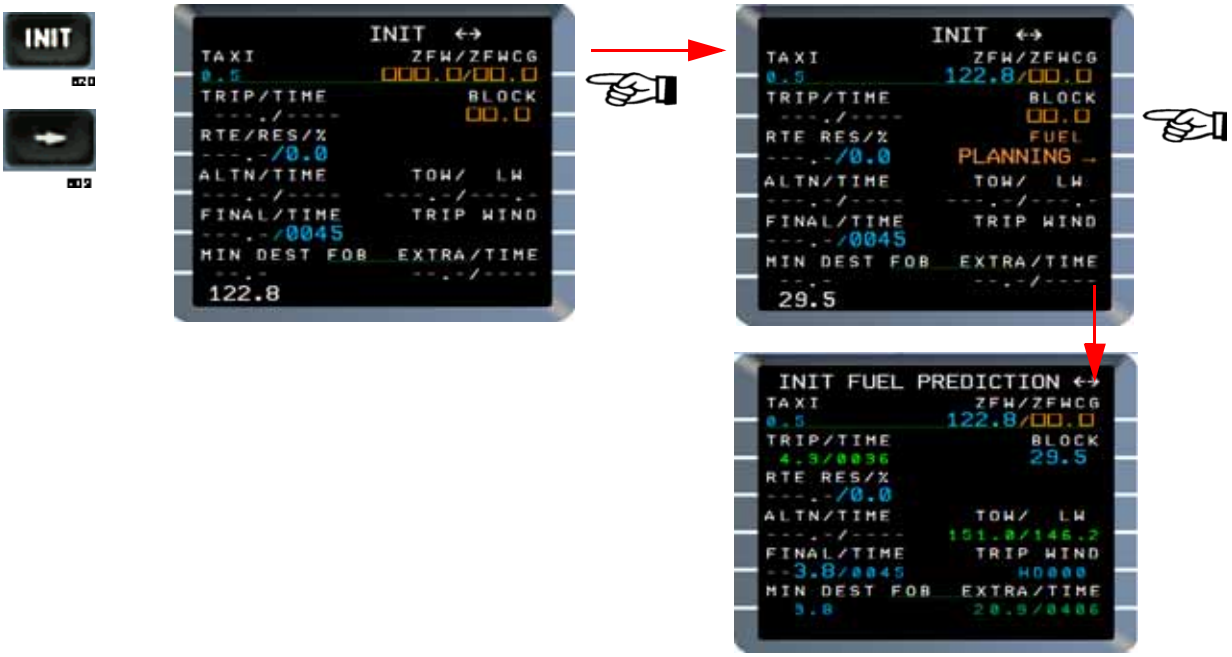
The WIND REQUEST prompt requests winds through the AOC function, this function can be used to uplink climb, cruise, and descent winds.

INIT Page B

General

The INIT page B is used to initialize aircraft zero fuel weight, modify the zero fuel weight center of gravity (ZFW CG), and to initialize fuel planning data. All weights are entered in thousands of pounds (e.g., 29,400 pounds is entered as “29.5”).

Arrows in the following diagram illustrate the results of ZFW and Block fuel data entry.



The INIT page B is only available before engine start, and in the DONE phase after landing. If the INIT page B is displayed when the engines are started, it will be replaced by the INIT FUEL PREDICTION page.

The computed fuel fields (displayed in green) are displayed after all necessary flight planning data (ZFW and block fuel) has been entered.

Note: Differences between FMS fuel predictions and DAL FPS 2 planning documents will occur due to differences in planning data. An exact correlation between the two should not be expected.

TAXI

The TAXI field displays the taxi fuel. The database taxi fuel defaults to 500 pounds. This value should be pilot modified to correspond to flight planning documents.

INIT Page B (continued)

TRIP/TIME

The FMS fuel burn and time en route along the flight plan route are displayed in green when FMS calculations are completed. These calculations are based on the entire flight plan route as entered on the F-PLN page, including SID, STAR, instrument approach and missed approach routings, when entered. The fuel burn also includes the fuel burn to a flight plan alternate, if an alternate is in the flight plan. This field remains blank until all required flight planning information is entered (for example, ZFW and BLOCK FUEL).

Note: Predictions are only as accurate as the information entered. Gross weight, winds, routing, temperature at cruise flight level, etc., must be entered correctly for accurate predictions.

RTE RSV / %

The desired route reserve (RTE RSV) fuel is either a pilot entered value or a default calculated value.

The fuel can be entered as either a fuel amount (RTE RSV) or a percentage (%) of the trip fuel. Pilot data entries are displayed in large font, with calculated data displayed in small font.

The compute value is the lessor of the pilot entered value or 15% of the flight plan burn.

ALTN/TIME

The amount of fuel and time to fly to the selected alternate airport is displayed. The routing to the alternate is that which has been entered in the active flight plan. If no alternate routing has been entered, a direct routing is assumed for predictions. The field is dashed if no alternate has been entered in the flight plan.

The pilot can also directly modify these fields by manually entering either the alternate fuel or time from the release.

FINAL/TIME

The minimum desired fuel quantity on arrival (decision fuel from the release) at the destination airport is entered in this field. When an entry is made in one field, the other is automatically calculated and displayed in small font. The default FINAL/TIME value is 45 minutes if nothing is entered.

In order to utilize DAL FPS 2 computed fuel values, the pilot must insert the Flight Plan Reserve Fuel from the Flight Plan Fuel block of the flight plan into this field.

Calculation are based on holding at 1500 feet above the destination airport (or alternate airport, if defined) in the clean configuration at green dot speed.

MIN DEST FOB

The value in this field represents the sum of ALTN and FINAL fuel.

INIT Page B (continued)

ZFW/ZFWCG

This field displays the default zero fuel weight center of gravity (ZFWCG) and displays a mandatory entry field (amber boxes) for entry of the aircraft zero fuel weight (ZFW).

When entered, these fields cannot be cleared, however they may be modified. Once entered, the FUEL PLANNING prompt appears.

BLOCK

The BLOCK field allows entry of the fuel on board prior to engine start. Entry of a value in the BLOCK field allows the FMS to calculate the aircraft gross weight and complete the flight planning calculations.

The BLOCK field can be filled in manually which then displays the INIT FUEL PREDICTION page.

After engine start the FMS automatically puts the Fuel On Board into the BLOCK field and the aircraft gross weight is automatically calculated and displayed on the FUEL PRED page.

FUEL PLANNING FUNCTION

Once the ZFW/ZFWCG and the BLOCK fuel are entered on the INIT B page, fuel prediction by the FMGC begins. (Note: if the BLOCK fuel is not entered by the pilot, the FMGC will begin predictions with engine start based on the actual FOB). The TOW and LW fields self populate with predicted values. The page title changes from INIT B to INIT FUEL PREDICTIONS.

INIT Page B (continued)

TOW

The TOW field displays the computed Take Off Weight (TOW).

LW

The LW field displays the computed Landing Weight (LW).

TRIP WIND

Trip wind is a field where one can enter the average head or tail component for the entire trip. The default value is zero, it may be modified be entering head/tailwind component in knots, preceded by “-”, “H”, or “HD” for headwind, or “+”, “T”, “TL” for tailwind.

If a wind entry is made via the WIND page, TRIP WIND cannot be entered and the field is dashed. Any value already entered is deleted. Trip wind cannot be re-entered unless wind data for CLB, CRZ, and DES are erased.

EXTRA/TIME

This field displays extra fuel and time available after subtracting the taxi, trip, reserve, alternate, and final fuel values from the block fuel.

This field cannot directly be modified by the pilot. However, if another field is set to zero (for example FINAL fuel), the calculated EXTRA fuel increases accordingly.

A negative EXTRA fuel quantity indicates that the fuel on board is less than that required to accomplish the flight plan routing, including the flight plan to the alternate (if any), pre-planned holding fuel, and required reserves. The flight plan and alternate routing must be verified, along with the entered values in the RTE/RSV and FINAL/TIME fields.

PERF Pages

Performance Pages

General

The performance (PERF) pages allow access to aircraft performance data for the current and future FMS flight phases. Selecting the PERF key displays the performance page corresponding to the active FMS flight phase. During preflight and after landing, the takeoff page is displayed.

Performance pages available are:

- Takeoff (TAKEOFF)
- Climb (CLB)
- Cruise (CRZ)
- Descent (DES)
- Approach (APPR)
- Go-around (GO AROUND)

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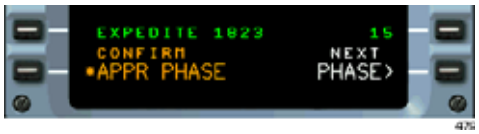
The NEXT PHASE prompt allows access to subsequent FMS pages.

After accessing a future phase of flight page, the previous phase prompt (PREV PHASE) is displayed which allows access to pages for preceding phases.

Performance pages for completed FMS phases cannot be accessed (with a few exceptions, discussed later).

Example: During preflight when the CRZ page is being viewed, selecting the PREV PHASE prompt will select the CLB page, and selecting the NEXT PHASE prompt will select the DES page.

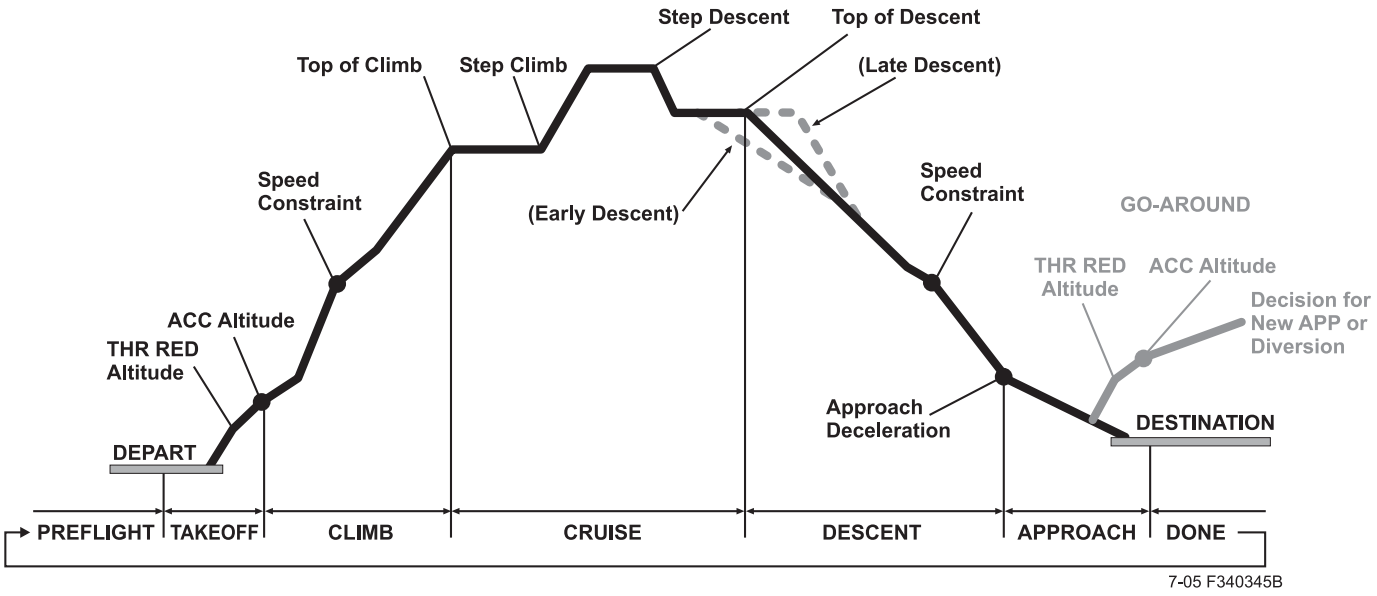
While the climb, cruise, descent, or go-around phases of flight are active, the associated PERF pages display the ACTIVATE APPR PHASE prompt. Selection of the prompt and a subsequent selection of the CONFIRM APPR PHASE at the same location, activates the approach phase.



Performance Pages (continued)

General (continued)

The FMS phases are shown below:



Performance Pages - TAKE OFF page

General

The TAKE OFF page is displayed from preflight until entering the climb phase and must be filled out prior to takeoff. It is also displayed after landing.

The TAKE OFF page allows the pilot to enter takeoff V speeds, modify the thrust reduction and acceleration altitudes, enter a reduced thrust takeoff flex temperature, and correct the FMS takeoff position for an intersection takeoff.

SWITCHING CONDITIONS

The FMGS transitions automatically from the PREFLIGHT phase to the TAKE OFF phase when the following conditions are met:

- Thrust levers set to the FLEX or TOGA detent, and,
- Left and right N1 > 85%, or,
- Ground speed > 90 kts.

FMS Computed Speeds

FMS computed F, S, and O (green dot) speeds (refer to chapter 22, Autoflight) are displayed in green in the center of the page after the aircraft gross weight and fuel quantity have been entered. These fields are dashed until calculated and cannot be pilot modified.

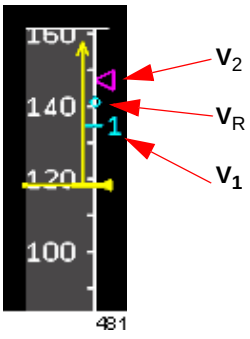
These speeds are depicted as:

- Minimum safe speed for flap retraction (FLP RETR or F)
- Minimum safe speed for slat retraction (SLT RETR or S)
- Maneuvering speed in the clean configuration (CLEAN or O)

V_1

Entry of V_1 is mandatory, as indicated by the amber boxes. V_1 is displayed as a blue V_1 on the PFD airspeed indicators after entry.

If the takeoff runway is changed after these values are entered, a CHECK TAKEOFF DATA message is displayed in the scratchpad. If the FROM airport is changed, the speed values are deleted.



Performance Pages - TAKE OFF page (continued)

V_R

Entry of V_R is mandatory, as indicated by the amber boxes. V_R is displayed as a small blue circle on the PFD airspeed indicators. (Ref. above)

If the takeoff runway is changed after these values are entered, a CHECK TAKEOFF DATA message is displayed in the scratchpad. If the FROM airport is changed, the speed values are deleted.

V_2

Entry of V2 is mandatory, as indicated by the amber boxes. V2 is displayed as a magenta triangle on both PFD airspeed indicators after entry. Entering V2 in this field with the IRs aligned clears the red SPD SEL (speed select) warning flags on both PFD airspeed indicators.

If the takeoff runway is changed after these values are entered, a CHECK TAKEOFF DATA message is displayed in the scratchpad. If the FROM airport is changed, the speed values are deleted.

In the example, the runway was changed creating the CHECK TAKE OFF DATA message. If the V speeds and FLEX TO TEMP is still valid, then selecting the CONFIRM TAKEOFF DATA will input the numbers listed in blue next to the individual boxes.

TRANS ALT

The transition altitude (TRANS ALT) corresponding to the flight plan departure airport is displayed in blue in this field. This database field can be pilot modified.

At altitudes above the transition altitude, the altimeter setting indication on the PFD flashes until standard (STD) is selected (refer to chapter 31, Flight Instruments).

The field is blank prior to entry of a departure airport in the flight plan. Brackets "[ ]"indicate that no transition altitude exists in the database for the selected departure runway.

Note: Changing the departure airport deletes pilot entries in this field and the default value is displayed.

THR RED/ACC

This field displays the thrust reduction/acceleration altitudes (THR RED/ACC) in blue. These fields default to departure airport elevation plus 1,000 feet prior to selection of runway. After runway selection they default to 1,000 feet above runway elevation. They can be pilot modified. Pilot entries are displayed in large font.

When the aircraft reaches the thrust reduction altitude, the FMA displays an amber LVR CLB annunciation, requesting the pilot to place the thrust levers in the CLB detent. This annunciation will occur at an altitude lower than the thrust reduction altitude if an earlier thrust reduction is required to capture the FCU altitude.

When the aircraft reaches the acceleration altitude, the FMS transitions to the climb phase. The flight guidance commands an acceleration to the climb speed and the FMA vertical mode changes from SRS to CLB or OP CLB (refer to chapter 22, Autoflight).

If the pilot has modified one or both fields, entering CLR at LSK 5L displays the default values.

Performance Pages - TAKE OFF page (continued)

RWY

The selected departure runway is displayed in green after it is entered in the flight plan. The departure runway is entered or changed on the flight plan page.

TO SHIFT [FT]

This field allows the pilot to correct the FMS takeoff position bias when using a displaced threshold or intersection takeoff. This TO SHIFT is measured from the approach end of the runway to the point at which takeoff thrust is applied.

If the field is blank, the FMS assumes that the aircraft is at the beginning of the runway when takeoff thrust is applied, and the resulting bias is applied to the mixed IRS position.

An entry in the TO SHIFT field is made in feet from the approach end of the runway. For example, if takeoff is started at an intersection 1,200 feet from the approach end, a “1200” entry is made in this field.

If the TO SHIFT field has a value, and subsequently the runway is changed, the TO SHIFT value will be deleted.

The field is dashed until a departure runway has been selected.

Note: The TO SHIFT value will be different than the runway remaining distance typically provided to the pilot.

FLAPS/THS

The takeoff flap setting and trimable horizontal stabilizer (THS) settings may be entered in this field, if desired. This field is provided as a reminder only. It does not affect the takeoff configuration warning or any other system. The flaps and takeoff trim must be set manually regardless of an entry in this field.

Allowable flap settings in this field are: 1, 2, and 3.

The THS entry requires an UP or down (DN) entry, as appropriate.

Example entries are:

- 1/UP0.8 (displayed as 1/UP0.8)
- 3/.7DN (displayed as 3/DN0.7)

Note: Incorrect entries have no effect on takeoff performance or any aircraft system.

Performance Pages - TAKE OFF page (continued)

FLEX TO TEMP

A reduced thrust takeoff setting (FLEX) temperature is entered in this field.

If no entry is made in this field, a (TOGA) thrust takeoff must be made. Setting the thrust levers to the FLEX/MCT detent during takeoff without an entry in this field causes a master caution and an ECAM message during takeoff. In this case, the master caution and ECAM message are cleared if the thrust levers are advanced to TOGA.

The entered FLEX temperature is also displayed on the E/WD.

The FLEX temperature can be cleared by entering CLR at LSK 4R. However, a TOGA thrust takeoff can be accomplished without clearing this field by advancing the thrust levers to TOGA.

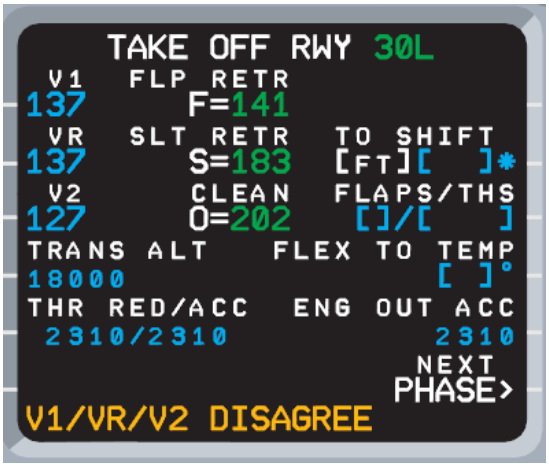
ENG OUT

This field displays the engine out acceleration altitude (ENG OUT ACC) in blue, which defaults to departure airport elevation plus 1,000 feet. This field can be pilot modified. Pilot entries are displayed in large font.

This field is a reminder only. It does not affect other systems. An entry in this field does not affect FMA displays or flight guidance modes following an engine failure.

T/O SECURING FUNCTION

Performs a takeoff speed consistency check by verifying V1 / VR / V2. If this condition is not satisfied a V1/ VR/ V2 DISAGREE (amber) scratchpad message is displayed. This check is performed when V-speeds are either manually entered or uplinked to the aircraft.



Performance Pages - CLB page

CLB Page

The climb (CLB) page allows the pilot to review climb performance and computed speeds, review computed climb predictions, and monitor the active climb flight guidance mode.

The FMGS switches automatically from TAKEOFF to CLB phase;

- When the A/C reaches the acceleration altitude, or,
- By engagement of another vertical mode.

Climb phase not yet active, 210 knots preselected

7/05 F340384C

CLIMB Phase active prediction to 10000

UTC DEST

The computed UTC displays the arrival time at the destination.

ACT MODE

The active (ACT) climb speed mode is displayed (refer to chapter 22, Autoflight). The active climb modes are:

- Managed - The FMS speed guidance providing the most economical climb speed at the current conditions.
- Selected - The active speed mode is selected, meaning the speed is manually controlled via the FCU speed window.

CI

The cost index (CI) is displayed in blue. This field can be modified by the pilot. Pilot entries are displayed in large font.

Performance Pages - CLB page (continued)

PRESEL

This field allows the pilot to pre-select a climb speed prior to the climb phase. *It is not present when the climb phase is active, it disappears when LVR CLB flashes on FMA.* The desired climb speed (or Mach) is entered in this field. When the climb phase becomes active (i.e., at the ACCEL ALT), the pre-selected speed appears in the FCU speed window and selected speed is the engaged speed mode. This feature can be used when a SID has a speed restriction (e.g., do not exceed 230 KIAS) to prevent the aircraft from accelerating to ECON climb speed.

Caution: *A pre-selected speed functions exactly the same as a FCU selected speed. If a speed above 250 KIAS is pre-selected, the aircraft will accelerate to that speed after passing the acceleration altitude and ignore the speed limit (i.e., 250 KIAS/10,000 feet).*

If managed speed is activated during the climb phase by pushing the FCU SPD knob, the pre-selected speed is no longer available.

DEST EFOB

The predicted estimated fuel on board (EFOB) at the destination is displayed.

When the climb phase is active, additional information is displayed on the CLB page. Data displayed in green cannot be modified.

Predictions are provided for the altitude displayed at 2R. This altitude is initially the FMS cruise altitude, as entered on the PROG page. This altitude can be pilot modified up to and including the FMS cruise altitude, displaying predictions for other altitudes as desired.

Example: This field can be used to determine the distance and time to reach FL370 during a climb to FL390. Once that modified altitude (in this example FL370) is passed, the FMS cruise altitude is automatically reselected.

Predictions are provided for the engaged climb mode and are also depicted for the expedite climb mode. The predictions are UTC time at the FMS climb altitude and remaining distance required to climb to the cruise altitude.

UTC DEST

The computed UTC arrival time at the destination is displayed.

Performance Pages - CLB page (continued)

MANAGED	This line displays managed speed climb predictions to reach the altitude displayed in the 2R field.
SELECTED	This speed is the current speed selected on the FCU speed window. It can be pre-selected as previously discussed. If managed speed is activated, this prompt is removed. When selected speed is active, this line displays selected speed climb predictions to reach the altitude displayed in the 2R field.
EXPEDITE	This line depicts the predicted time and distance required to reach the cruise altitude as displayed in the 2R field with the expedite climb (EXP CLB) mode active. These predictions are always present, allowing the pilot to compare the currently engaged climb mode performance to the expedite mode.
PREVIOUS PHASE	This prompt is displayed before CLB is the ACTIVE PHASE, allowing the TAKE OFF page to be re-selected.
NEXT PHASE	This prompt allows the CRZ page to be displayed.
ACTIVATE APPR PHASE	This prompt is displayed only when the CLIMB phase is active. Selecting this prompt once results in an amber CONFIRM APPR PHASE prompt. Selecting this prompt a second time activates the FMS approach phase. Selecting a different MCDU page with the CONFIRM APPR PHASE prompt present cancels the prompt.
PRED TO	This field initially displays the FMS cruise altitude, as entered on the INIT A or PROG page. Predictions to other altitudes up to and including the FMS REC MAX altitude are available by entering the desired altitude in this field. Clearing a pilot entered altitude from this field causes the FMS cruise altitude to be re-displayed.

Performance Pages - CRZ page

General

The PERF CRZ page allows entry of a pre-selected cruise speed, the maximum cabin descent rate, step altitudes, and provides en route predictions.

Note: These actions must be selected prior to entry in to the cruise phase, as they will not be allowed once the cruise phase is active.

The cruise phase is active from the time the aircraft reaches the FMS cruise altitude until the descent phase begins. If the aircraft levels off for an extended period below the cruise altitude, the cruise phase can be manually activated by changing the cruise altitude on the PROG page to the FCU altitude. This action automatically engages the Soft Altitude Hold Mode when the aircraft reaches this new cruise altitude (refer to chapter 22, Autoflight).

The cruise phase can be manually re-activated from the descent, approach, or go-around phases, if desired, by entering a new cruise altitude (on the PROG page) equal to the current aircraft altitude.

Cruise Phase not yet active

Cruise phase active with predictions to the T/D

UTC DEST

The computed UTC arrival time at the destination is displayed.

EFOB

The EFOB (estimated fuel on board) displays the FMS computed fuel on arrival at the destination airport

ACT MODE

The ACT MODE displays the active speed mode for this phase. The active cruise speed modes are:

- MANAGED - The FMS speed guidance providing the most economical cruise speed at the current conditions.
- SELECTED - The active speed mode is selected, meaning the speed is manually controlled via the FCU speed window.

Performance Pages - CRZ page (continued)

CI

The cost index (CI) is displayed in blue as previously entered on INIT page A. This field can be modified by the pilot. Pilot entries are displayed in large font.

If an engine out condition is detected by the FMS, it is replaced by EO LRC (Engine Out Long-Range Cruise).

If there is a time constraint in the flight plan, the CI indicates TIME CSTR. Although the TIME CSTR is displayed in blue, it cannot be cleared or overwritten. Any attempt will result in a NOT ALLOWED message in the scratchpad.

MANAGED

The field displays the most economical cruise speed/Mach.

This field can display just a calibrated airspeed (CAS) or a MACH derived from the altitude and cost index.

PRESEL/ SELECTED

Prior to reaching cruise altitude, the pilot can enter a desired cruise speed in either Mach (e.g., .78) or KIAS (e.g., 290). This speed is a pre-selected speed which will engage when the aircraft reaches the FMS cruise altitude.

Prior to the FMS cruise phase, an entry in this field cannot be cleared utilizing the CLR pb and selecting LSK 4L. However it may be overwritten. To clear the PRESEL field, selecting LSK 3L (*.80 in this example), will nullify the PRESEL field and will change the ACT MODE back to MANAGED.

The SELECTED indication at LSK 4L indicates that the aircraft's current speed is a selected speed via the FCU speed window.

Pushing the FCU speed knob will remove the SELECTED field from the display and the ACT MODE will revert back to MANAGED.

Performance Pages - CRZ page (continued)

PREVIOUS PHASE

This prompt allows access to the CLB phase before the CRUISE phase is active.

ACTIVATE APPR PHASE

This prompt is displayed only when the CRUISE phase is active. Selecting this prompt once results in an amber * CONFIRM APPR PHASE prompt. Selecting this prompt a second time activates the FMS approach phase.

Selecting a different MCDU page with the * CONFIRM APPR PHASE prompt present cancels the prompt.

NEXT PHASE

This prompt allows the DES page to be displayed.

TO/ UTC/ DIST

The PERF CRZ page provides ETA and distance predictions to:

- The next step climb (S/C) or step descent (S/D) point
- The driftdown altitude (if an engine out condition exists and the aircraft is above the driftdown altitude
- The top-of-descent point (T/D)

DES CABIN RATE

The default cabin re-pressurization schedule of -350 ft./min. is displayed in this field. This field can be pilot modified and will result in a large blue font. Modifications to this field result in changes in the predicted top of descent point. For example, reducing the rate of descent to “-200” would result in a predicted top of descent point significantly earlier in the flight. Entering CLR in this field results in the default value being displayed.

Performance Pages - DES page

General

The PERF DES page allows entry or review of the descent performance and computed speeds, computed descent predictions, and also allows the pilot to monitor the active descent flight guidance mode.

The FMGS switches automatically from CRUISE (CRZ) to DESCENT (DES) phase when:

- A lower ALT is selected on FCU at less than 200 NM to the destination airport, or,
- ALT selected on FCU is at or below the higher of FL200 or highest DES ALT CSTR.

Descent phase not yet active

Active descent phase

UTC DEST

The computed UTC arrival time at the destination is displayed.

EFOB

The EFOB (estimated fuel on board) displays the FMS computed fuel on arrival at the destination airport

ACT MODE

The ACT MODE displays the descent speed mode. The active descent modes are:

- MANAGED - The FMS speed guidance providing the most economical cruise speed at the current conditions.
- SELECTED - The active speed mode is selected, meaning the speed is manually controlled via the FCU speed window.

CI

The cost index (CI) is displayed in blue as previously entered on INIT page B. This field may be modified by the pilot. Pilot entries are displayed in large font.

Performance Pages - DES page (continued)

PRESEL/ SELECTED

The pilot can enter a desired descent speed in either Mach (e.g., .78) or KIAS (e.g., 290). This speed will become active in the descent phase.

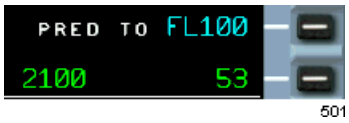
An entry in this field can be cleared utilizing the CLR pb and selecting LSK 3L. It may also be overwritten.

While in the DESCENT phase, the SELECTED indication at LSK 4L indicates that the aircrafts current speed is a selected speed via the FCU speed window.

Pushing the FCU speed knob will remove the SELECTED field from the display and the ACT MODE will revert back to MANAGED.

PRED TO/ UTC/ DIST

The PERF DES page provides ETA and distance predictions to:



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- The altitude in the FCU altitude window, this is the default value.
- A manually inserted altitude that is higher than the altitude that is in the FCU altitude window up to and including the REC MAX altitude.

EXPEDITE

This line displays the predicted time and distance required to descend to the reference altitude in the PRED TO field with the expedite descent (EXP DES) mode active. These predictions are always present, allowing the pilot to compare the currently engaged descent mode performance to the expedite mode.

PREVIOUS PHASE

This prompt allows access to the CRUISE phase before the DES phase is active.

NEXT PHASE

This prompt allows the APPR page to be displayed.

ACTIVATE APPR PHASE

Depressing this prompt once results in an amber * CONFIRM APPR PHASE prompt. Selecting this prompt a second time activates the FMS approach phase.

Selecting a different MCDU page with the * CONFIRM APPR PHASE prompt present cancels the prompt.

Performance Pages - APPR page

General

The PERF APPR page allows entry of arrival environmental information, MDA or DH, and landing flap setting.

The approach phase can be manually activated in flight by using the ACTIVATE APPR PHASE prompt on the page for the current phase of flight.

The approach phase is automatically activated when the deceleration (DECEL) point is sequenced when in managed lateral NAV mode. Activation of the approach phase allows the aircraft to slow to the appropriate maneuvering speed for the current flap configuration, (described in chapter 22, Autoflight).

FMS Computed Speeds

FMS computed F, S, and O (green dot) speeds (refer to chapter 22, Autoflight) are displayed in green in the center of the page. These fields are dashed until calculated and cannot be pilot modified.

These maneuvering speeds are depicted as:

- Minimum speed with flaps at 2 or 3 (FLP RETR or F)
- Minimum speed with flaps at 1 (SLT RETR or S)
- Minimum speed in the clean configuration (CLEAN or O).

QNH

The destination altimeter setting is entered in this mandatory field.

The altimeter setting can be entered in millibars (e.g., 1017) or inches Hg (e.g., 29.75). A decimal point is required when entering a value in inches Hg.

TEMP

The destination temperature (TEMP) is entered in this field in degrees Celsius. The temperature entry increases the accuracy of aircraft performance predictions.

Performance Pages - APPR page (continued)

MAG WIND

The destination airfield steady state magnetic (MAG) wind is entered in this field. The FMS computes the runway headwind component from this entry and increases the approach speed (V_{APP}) as necessary, (refer to chapter 22, Autoflight). This wind is also used for descent path computations.

Once an entry has been made in this field, it can only be modified. It cannot be cleared.

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The destination airfield wind can also be entered via a vertical revision of the destination airport on the flight plan page. The wind direction on that page is entered as a true wind, and is automatically converted to a magnetic wind when displayed on the APPR page. The opposite conversion also occurs: The entry of a magnetic wind on the APPR page automatically displays a true wind on the flight plan vertical revision page at the destination.

TRANS ALT

The database transition altitude (TRANS ALT) corresponding to the flight plan destination airport is displayed in blue in this field. It can be pilot modified.

Example: At Detroit (KDTW) the transition altitude is 18,000 feet, while at Montego Bay, Jamaica (MJKS), it is 8,000 feet.

At altitudes below the transition altitude, the altimeter setting indication on the PFD flashes until a QNH reference is selected (refer to chapter 31, Flight Instruments).

Brackets “[ ]” indicate that no transition altitude exists in the database for the selected destination runway.

Note: Changing the destination airport deletes pilot entries in this field and the default value is displayed.

VAPP

The FMS computed approach speed (V_{APP}) for the current gross weight and environmental conditions is displayed in this field. V_{APP} is the managed speed in the landing configuration when the approach phase is active. This field can be pilot modified. Pilot entries are displayed in large blue font. For example, a landing with jammed flaps is planned and an increase of 25 knots in V_{APP} is required. The new V_{APP} can be entered in this field, and the approach flown using managed speed.

V_{APP} increases in proportion to the calculated runway headwinds with an entry at 3L (refer to chapter 22, Autoflight).

V_{APP} increases by 5 knots when CONF 3 is selected at 4R.

Note: Following pilot modification of Vapp, If the DEST RWY is changed, Vapp will revert to its originally computed value.

Performance Pages - APPR page (continued)

V_{LS}

The FMS computed lowest selectable speed (V_{LS}) is displayed in this field. This V_{LS} is computed for the planned landing configuration (normally flaps FULL) at the current gross weight.

Note: Do not confuse this V_{LS} with the V_{LS} displayed on the PFD airspeed indicator. The V_{LS} displayed on the PFD airspeed indicator is computed for the current aircraft configuration, while the V_{LS} displayed on this MCDU page is computed for the planned landing configuration.

V_{LS} increases by 5 knots when CONF 3 is selected at 4R.

FINAL

The flight plan selected approach (e.g. ILS30L) is displayed in this field after an approach is entered into the flight plan. The field is in green, which means in cannot be modified via this page.

BARO

The MSL minimum descent altitude (MDA/DA) for a non-precision approach is entered in this field. When the aircraft descends below this barometric altitude on the approach, the barometric altitude window on the PFD altimeter turns amber.

During a non-precision approach using FINAL and APP NAV modes, the autopilot remains engaged at the MDA/ DA, requiring pilot action in order to ensure the autopilot is disconnected when descending below minimums. The approach profile remains active (providing accurate vertical/ lateral guidance) until 50' AGL.

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This field clears when the destination or runway is changed in the flight plan.The BARO value entered is displayed as MDA on the FMA in column 4 when the descent or approach phases are active.

RADIO

The AGL decision height (DH) is entered in this field. When conducting a precision approach requiring the use of the radio altimeter for determination of minimums a numerical entry is made in this field, the aural callouts during landing change to the following:

- 100 feet above the DH ONE HUNDRED TO MINIMUMS is annunciated, and
- At the DH MINIMUMS is annunciated.

In addition, a large amber DH appears on the PFD when the aircraft reaches the decision height on the radio altimeter.

For category III approaches without a specific decision height, "100" is entered in this field to correspond to a 100' alert height.

This field clears when the destination, instrument approach procedure, or runway is changed in the flight plan.

This field is not displayed when a database non-precision approach is entered into the flight plan.

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The RADIO value entered is displayed as DH on the FMA in column 4 when the descent or approach phases are active

Performance Pages - APPR page (continued)

LDG CONF

These prompts are used to select the planned landing flap configuration (LDG CONF) The adjacent LSK is pressed to select the desired configuration. The selected configuration is displayed in large blue font.

Selecting CONF 3 increases V_{LS} and V_{APP} by 5 knots.

The flaps FULL configuration is reselected at the FMS done phase.

Performance Pages - GO AROUND page

GO AROUND Page

The GO AROUND page allows the pilot to review computed maneuvering speeds, default thrust reduction/acceleration (THR RED/ACC) altitudes, and the default engine-out acceleration (ACC) altitude.

The go-around phase is active after a go-around has occurred. Two conditions are required for the FMS to recognize a go-around:

- Go-around thrust is applied (TOGA), with
- Flap lever at CONF 1 or greater.

When the go-around phase is active, the PREV PHASE prompt at 6L is replaced with the ACTIVATE APPR PHASE prompt. This prompt allows the approach phase to be reactivated for subsequent approaches.

The go-around phase transitions to the climb phase when a new destination is entered into the flight plan or a new cruise flight level is entered on the PROG page.

The go-around phase transitions to the approach phase when the FCU altitude is selected below the aircraft altitude and the land mode is armed (FCU APPR pb depressed).

THR RED/ACC

The thrust reduction/acceleration (THR RED/ACC) altitudes are depicted in the same manner as on the TAKEOFF page. The default value of 1,000 feet AGL is referenced to the destination runway elevation. This field can be pilot modified.

ENG OUT ACC

The engine-out acceleration (ENG OUT ACC) altitude is depicted in the same manner as on the TAKE OFF page. The default value of 1,000 feet AGL is referenced to the destination runway elevation. This field can be pilot modified.

Intentionally Left Blank

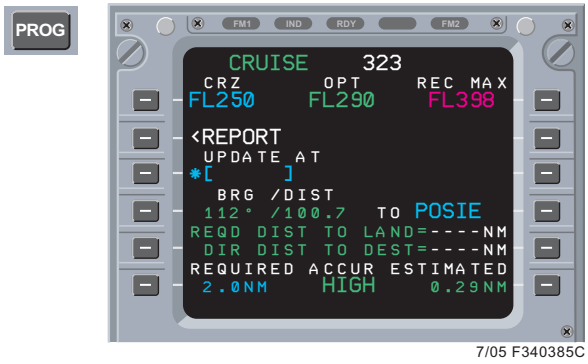
PROG Page

Progress Pages

General

The progress (PROG) page displays dynamic flight information that is constantly updated by the FMS. The progress page displays:

- The active FMS flight phase
- The flight number
- The cruise flight level (CRZ)
- The optimum (OPT) flight level
- The recommended maximum (REC MAX) flight level
- An FMGC update field
- Bearing/Distance (BRG/DIST) to a pilot selected waypoint or destination
- Required (REQD) and direct (DIR) distance to land
- FMGC navigation accuracy level



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Title Line

The title line displays:

- The active FMS flight phase
- The flight number as entered on INIT page A

Progress Page (continued)

CRZ FL

The cruise flight level (CRZ FL) is initially the flight level entered by the pilot during preflight on the INIT page A. Reflecting the clearance altitude set on the FCU, the cruise flight level will be automatically updated if the altitude on the FCU is set to a higher value.

When the aircraft reaches the cruise flight level, the soft altitude hold mode engages (refer to chapter 22, Autoflight), as indicated by green ALT CRZ in column two of the FMA. If the aircraft has been leveled off at an altitude below the cruise flight level, and an extended cruise at this altitude is expected, the cruise flight level should be changed to engage the CRUISE PHASE and to allow the soft altitude hold mode to engage.

If the pilot did not enter a cruise flight level during preflight, this field displays the FCU altitude. During cruise, it is not possible to insert a cruise flight level below the FCU altitude.

When the descent phase is activated, this field is dashed white.

This field can be used to re-establish the cruise FMS phase. For example, if the pilot has accidentally activated the FMS approach phase, managed cruise and descent speeds are not available unless the cruise phase is re-established.

Entering an altitude above the current altitude in the CRZ FL field reactivates the climb phase.

Entering the current altitude in the CRZ FL field reactivates the climb phase.

Flight plan altitude constraints cannot be entered at altitudes equal to or higher than the cruise flight level.

The maximum cruise level is limited to FL390.

OPT

The optimum (OPT) altitude is computed considering a 1.5 G buffet margin.

The OPT altitude is computed using the current aircraft gross weight, cost index, ground speed, performance factor, and assumes a minimum of 15 minutes of cruise flight.

During preflight, the ISA standard temperature at the cruise flight level is corrected for deviations if a non-standard temperature has been entered for the cruise altitude on INIT page A. This allows the OPT and REC MAX flight levels to correctly depict the aircraft's aerodynamic capabilities.

This field will be dashed when:

- The DESCENT phase is active
- 15 NM prior to the top-of-descent
- During an engine out condition

Progress Page (continued)

REC MAX

When all engines are running, the REC MAX altitude is computed using the following conditions:

- Stabilized in level flight with less than MAX CRUISE thrust
- Speed maintained between GREEN DOT and VMO/MMO
- It can be reached with a minimum climb rate of 300 ft./mn using MAX CLB thrust
- Altitude is less than maximum certified altitude
- A 1.3 G buffet margin can be maintained

If an engine fails, the REC MAX altitude is computed at the single engine long-range cruise (LRC) speed, with one engine operating at maximum continuous thrust (MCT) and the other engine wind-milling, engine anti-ice off, and a 1.3 G buffet margin.

The computed single-engine REC MAX altitude allows for a slight climb capability (which can be increased by slowing from the LRC speed toward green dot).

Note: The single-engine ceiling at green dot airspeed is significantly higher than the depicted single engine REC MAX altitude at LRC.

If the EO CLR prompt is selected, the REC MAX altitude reverts to normal two engine calculations. This prompt is discussed in the Engine Out section of this chapter.

VDEV

While in the descent phase, the PROG page displays vertical deviation (VDEV). It represents the computed difference between the current aircraft altitude and the altitude it should be flying as computed by the FMS for the planned vertical profile. This deviation is in feet.

Note: Aircraft must be in managed NAV to display the VDEV.

Progress Page (continued)

UPDATE AT

This field allows the pilot to update the position of both FMGCs simultaneously. An update should only be made under unusual circumstances when a large FMS position error has been confirmed.

The pilot performs the update by entering the identification of the update point using:

- LAT/LONG
- PBD
- PBX
- WAYPOINT
- NAVAID
- RUNWAY:

The aircraft must be navigated using raw data or other means directly overhead the selected waypoint (in this example, DLL). The amber CONFIRM UPDATE AT prompt at 5R is selected when the aircraft is directly over DLL. Minor position errors entered during this update are eliminated quickly as the FMS radio position corrects the error.

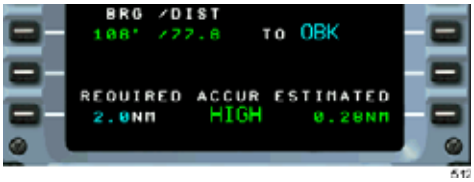
Caution: *Caution should be used when performing an FMS update. The aircraft must be at or near the entered update position when the CONFIRM UPDATE AT prompt is selected. If a large error is inserted, subsequent automatic FMS radio position updates may not be possible as navaids fail to meet the reasonableness test and, therefore, are not used for radio navigation. Multiple FMS position updates may be made if necessary. A map shift will occur if the update is not entered over the exact location. If this occurs, the ND display no longer has valid positioning information and should not be used (until GPS or DME/DME position updating takes place).*

If the UPDATE AT prompt is selected in error, selecting any other MCDU page cancels the prompt.

Progress Page (continued)

BRG/DIST

The pilot can enter the identifier of any point (waypoint, airport, runway, navaid, LAT/LONG, PLACE/BRG/DIST, or PLACE-BRG/PLACE-BRG), and the direct bearing and distance (BRG/DIST) to that point is displayed. Each MCDU can simultaneously display a BRG/DIST to a different point.



FMS NAVIGATION ACCURACY

The accuracy level of the pilot's own FMGC is displayed as either HIGH or LOW (refer to section 20 of this chapter.)

REQ'D DIST TO LAND

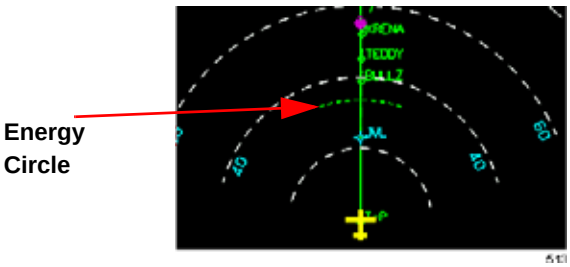
When the aircraft is within 180NM of the destination, and in selected lateral mode (HDG or TRK), both the REQD DIST TO LAND and DIR DIST TO LAND may be displayed during CLB, CRZ, or DES phases.

Note: GPS equipped aircraft only: The REQD DIST TO LAND and DIR DIST TO LAND are replaced by PREDICTIVE GPS and GPS PRIMARY.

The REQD DIST TO LAND is a minimum lateral distance required to change from the current aircraft altitude to the destination airport elevation on the descent profile at the current energy state.

The descent profile includes any existing speed limit, wind compensation and an approach segment with a level deceleration segment

A dashed green arc, called the "energy circle", will be displayed on the ND in the ARC and NAV modes. The arc is aligned with the aircraft with a radius equal to the required distance to land.



The DIR DIST TO LAND is equal to the direct distance from the aircraft's present position to the LOC capture point (LCP) + the distance from the LCP to the runway threshold.

If no approach is defined, then the direct distance to destination is the direct distance from the aircraft's present position to the destination airport.

Progress Page - REPORT page

General

The REPORT page is a read only page organized in the same manner as a standard position report and is in the same format as the Delta Jeppesen printed flight plan.

This page displays information related to the active flight plan, and in particular the from (OVHD), TO, NEXT and DEST waypoints with their associated time (UTC) and altitude (ALT).

It also features environmental data such as static air temperature and current wind if required. Fuel on board (FOB) related to the OVHD waypoint is also provided.

While in the cruise phase, additional information is available. This information is relative to the next vertical change (i.e., Step Climbs [S/D], Top of Descent [T/D], Step Descent [S/D] and includes:

- Time to the vertical change in UTC
- Distance (DIST) to the vertical change.

The last line of the report page is destination information:

- Destination airfield and runway information
- UTC time at destination
- Distance remaining to destination
- EFOB (Estimated fuel on board) at destination

Note: This page is formatted in the same fashion as the position reports required on some international or overwater flights.

SEND Prompt

This prompt will allow the report to be sent to the SOC/Dispatcher via the AOC. This function is presently not available.

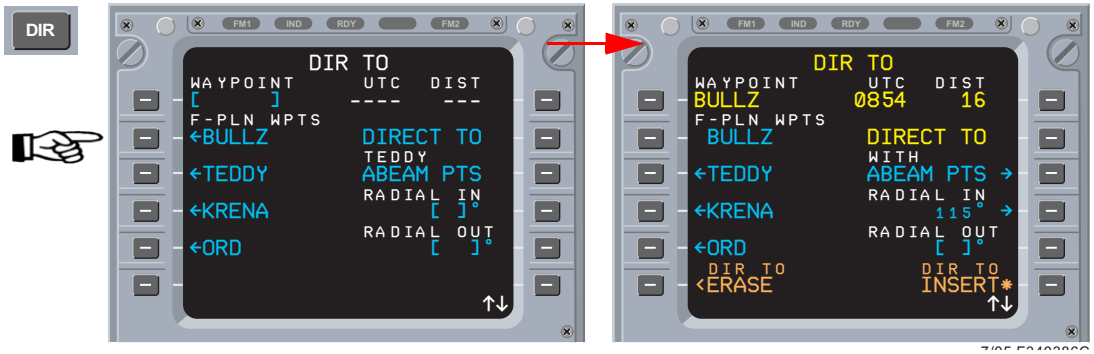
DIR TO Page

Direct To Page

General

The DIR TO page allows:

- The creation of a direct to leg from the aircraft's present position to any waypoint
- The creation of a direct to leg from the aircraft's present position to any waypoint with additional waypoints located abeam the previous flight plan's waypoints on the direct to leg.
- The creation of an intercept leg defined by an entered radial into or out of the selected waypoint.



DIR TO

Selecting the DIR prompt, displays the DIR TO page.

With the DIR TO page displayed, a DIR TO function can be performed by one of four methods:

- The DIRECT TO at LSK 2R
- With ABEAM PTS at LSK 3R
- RADIAL IN at LSK 4R
- RADIAL OUT at LSK 5R

DIRECT TO

The WAYPOINT field accepts entries of any waypoint to reference the direct to and intercept function. The waypoint can be entered by:

- Line selecting the desired flight plan waypoint
- Entering a waypoint name
- Entering a place/bearing/distance
- Entering a place-bearing/place-bearing
- Entering a latitude/longitude

Note: If a latitude/longitude is entered, or any unknown waypoint, the NEW WAYPOINT page is automatically called up.

Once a waypoint is entered, the temporary DIR TO page is displayed with the DIRECT TO prompt as the default selection as indicated by the yellow font color. (Reference illustration above). Also displayed on the temporary DIR TO page is the UTC time of arrival and DIST (distance) to the DIR TO with the appropriate direct to applied.

DIR TO Page (continued)

DIRECT TO (continued)

Selecting the DIRECT TO prompt at LSK 2R:

- Will perform a direct routing to the selected waypoint without any other waypoints in between.
- Creates a DIR TO temporary flight plan.
- Selection of the DIR TO INSERT prompt at LSK 6R is required to complete the intercept;
  - Managed NAV mode engages
  - Changes the temporary flight plan to the active flight plan. (Example of a DIR TO DEVON is displayed below).

1. Select the DIR key on the MCDU.

2. DIR TO page is displayed, use the up arrow to scroll the F-PLN until DEVON is displayed.

3. Select LSK 4L to DEVON as the DIR TO waypoint.

4. Select the DIR TO INSERT prompt at LSK 6R to complete the DIR TO.

DIR TO Page (continued)

DIRECT TO (continued)

Prior to selecting the DIR TO INSERT prompt, both NDs display the active flight plan and the lateral path generated by the DIR TO as a temporary trajectory.

No lateral or vertical revisions are permitted or will be executed on the temporary flight plan when performing a direct to. Trying to perform a flight plan revision will trigger the DIR TO IN PROGRESS scratchpad message.

Selecting the prompt DIR TO ERASE at LSK 6L will erase the direct to and return the display to the flight plan page.

DIR TO Page (continued)

ABEAM PTS

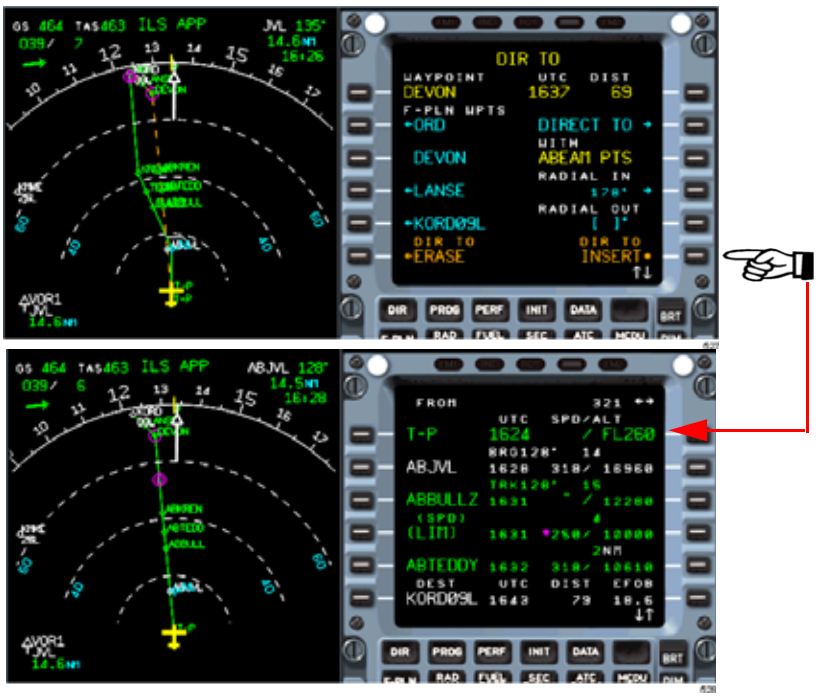
The WITH ABEAM PTS prompt inserts waypoints abeam previous or original flight plan waypoints along the direct-to route up to the selected direct to waypoint.

Selecting the WITH ABEAM PTS prompt:

- Defines a direct leg from the present position to the selected waypoint.
- Waypoints are created along the direct to leg that are perpendicular to the previous flight plan waypoints.Flight plan winds are also retained when using ABEAM points.
- Selection of the DIR TO INSERT prompt at LSK 6R is required to complete the intercept. Selecting the prompt:
  - Engages managed NAV mode
  - Changes the temporary flight plan to the active flight plan.

The present position becomes the from waypoint. The active flight plan displays this waypoint as T-P (Turn Point).

The abeam waypoints appear on the flight plan page in the format of ABXXXXX, where XXXXX is the first five characters of the reference fix (e.g., ABBULLZ, etc.) The DIR TO waypoint is displayed in the upper right hand corner of the ND.



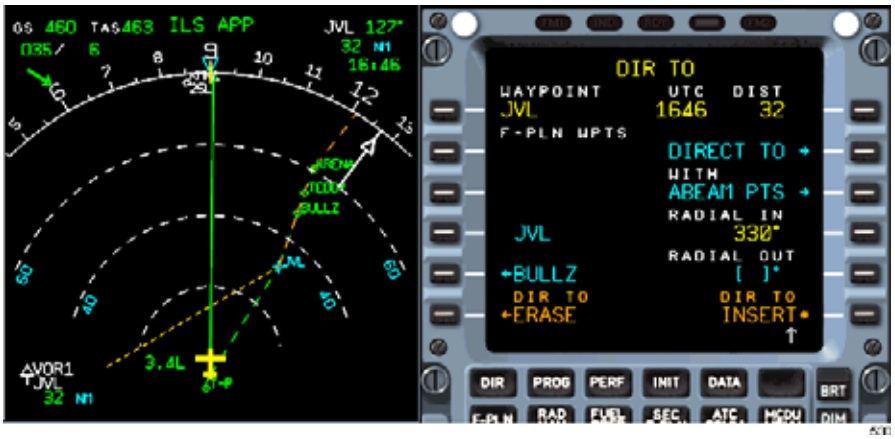
DIR TO Page (continued)

RADIAL IN and RADIAL OUT

The RADIAL IN prompt allows the interception of a course to the selected waypoint. The RADIAL OUT prompt allows the interception of a course from the selected waypoint. The desired intercept radial of the reference waypoint is entered into the RADIAL IN field or RADIAL OUT field.

If the waypoint already exists in the flight plan, a default value is displayed in the RADIAL IN field. The default value for the inbound radial is equal to the flight plan's original inbound course to the way point; however, the direct routing and not the default radial is initially displayed on the ND as a temporary flight plan line. The RADIAL IN default value may also reflect the radial between two waypoints if they are defined in the MCDU flight plan. No default value is provided for RADIAL OUT.

If a value is entered into the RADIAL IN or RADIAL OUT fields, the temporary flight plan line on the ND displays the entered radial. Multiple entries can be made to the RADIAL IN or RADIAL OUT fields while the temporary flight plan line on the ND is evaluated. After an entry is made, the radial value is displayed on the ND with the temporary flight plan line, allowing adjustment of the radial (e.g., to avoid weather).



DIR TO Page (continued)

RADIAL IN and RADIAL OUT (continued)

The selection is not inserted into the flight plan until the DIR TO INSERT prompt is selected.

After inserting the direct to, the message ADJUST DESIRED HDG/TRK is displayed in the scratchpad, advising that the aircraft heading or track can be modified for the intercept. No action is required to complete the intercept.

Selecting the RADIAL IN prompt:

- Activates the intercept radial into the reference waypoint
- Sets the inbound course to the reciprocal of the desired radial (+180)
- Selection of the DIR TO INSERT prompt at LSK 6R is required to complete the intercept. Selecting this prompt:
  - Engages Managed NAV mode
  - Changes the temporary flight plan to the active flight plan.
- The present position becomes the from waypoint. The active flight plan displays this waypoint as IN-BND (inbound).

DIR TO Page (continued)

RADIAL IN and RADIAL OUT (continued)

Selecting RADIAL OUT prompt:

- Activates the intercept radial from the referenced waypoint
- Sets the outbound course to the entered radial value.
- Selection of the DIR TO INSERT prompt at LSK 6R is required to complete the intercept. Selecting this prompt:
  - Engages Managed NAV mode
  - Changes the temporary flight plan to the active flight plan.
- The present position becomes the from waypoint. The active flight plan displays this waypoint as OUT-BND (outbound).

Temporary flight plan

Active flight plan

From waypoint is OUT-BND on flight plan page

Intentionally Left Blank

F-PLN Pages

Flight Plan Pages

Flight Planning General

There are three types of flight plans:

- Active flight plan
- Temporary flight plan
- Secondary flight plan

Active Flight Plan

The active flight plan is the routing that the aircraft is expected to follow. If in managed lateral NAV mode, the flight guidance follows the active flight plan. The colors of the three types of flight plans are consistent on both the MCDU and the ND. The active flight plan is composed of up to three sections:

- The flight plan routing from the departure airport to the destination (depicted in green),
- A missed approach routing (depicted in blue)
- A routing from the destination to the alternate destination (depicted in dashed blue).

Temporary Flight Plan

The temporary flight plan is a change to the active flight plan which has not been inserted. A temporary flight plan allows the pilot to preview flight plan reroutes, approach procedures, etc. before insertion into the flight plan. A temporary flight plan is depicted in yellow.

Secondary Flight Plan

The secondary flight plan is a stored flight plan which is identical to the active flight plan when initially stored. Segments of the secondary flight plan are automatically erased when the identical active flight plan segment is sequenced. If the active flight plan is modified, the original routing in the secondary flight plan is retained and can be displayed for reference. The secondary flight plan is depicted in white.

The secondary flight plan can also be modified, allowing the pilot to prepare for a different arrival option.

Flight Plan Pages (continued)

General

The flight plan pages display all the waypoints of the active, temporary, and secondary flight plans along with associated predictions.

This allows for the construction, monitoring or modifying of the flight plans.

Revisions to the lateral and vertical flight plans are accessed through the flight plan pages using the left and right LSKs respectively.

Flight plan pages A and B are available in both the active and secondary flight plans. In addition to the listing of waypoints, flight plan page A displays time, speed, and altitude predictions, while flight plan page B displays fuel and wind predictions.

Flight Plan Pages

The flight plan page A can be accessed with either the F-PLN or AIRPORT keys

F-PLN page A

or

F-PLN page B

The data fields common to both flight plan page A and page B are as follows.

Flight Plan Pages (continued)

FROM Waypoint

The current leg begins at the FROM waypoint and continues to the TO waypoint. When enroute it is usually the waypoint on the flight plan that has been most recently sequenced or flown past. The FROM waypoint cannot be directly modified. The altitude and time are memorized when the FROM waypoint is sequenced and displayed for use by the FMS in predicting the ETA, fuel and airspeed at the TO waypoint.

FPLAN Page A

The FROM waypoint is normally the most recently sequenced waypoint, (e.g., JVL). The FROM waypoint can also be displayed as:

- The Present Position (PPOS)
- A turn point (T-P). When the FROM waypoint is a turn point generated by the FMS when intercepting a managed NAV course. For example, when a DIR TO has been entered, the FROM waypoint is a T-P
- A IN-BND or OUT-BND when the from waypoint was a turn generated by the FMS for intercepting inbound radials or outbound radials.

When the FROM waypoint is in line L1, FROM is displayed above the waypoint. If the flight plan has been scrolled, FROM is no longer displayed. Selecting the F-PLN key returns the flight plan to the top line and displays the FROM waypoint.

TO Waypoint

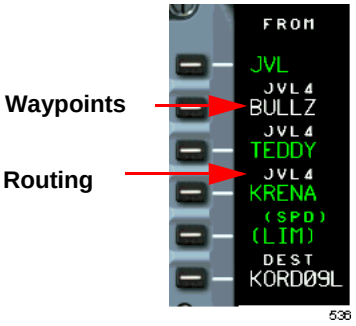
The TO waypoint normally is the next waypoint in the flight plan after the FROM waypoint. It is the point to which the FMS is guiding the aircraft in managed NAV. The TO waypoint is displayed in white, normally on the second line of the flight plan. The TO waypoint may be pushed further down into the flight plan listing by pseudo waypoints (e.g., T/C, T/D, S/D, ETC.); however, it remains as the designated TO waypoint and continues to be displayed in white. The name of the TO waypoint is normally displayed in white in the upper right corner of the ND (Note: the exception to this is when a DIR TO with ABEAM points is selected. In this case the DIR TO waypoint will be displayed on the ND).

Predicted time of arrival at the TO waypoint (TIME or UTC) is displayed in the second column. The bearing (BRG) and distance in nautical miles (NM) to the TO waypoint is depicted in white.

Flight Plan Pages (continued)

Waypoints

The waypoint fields display the identifiers for the flight plan waypoints. The FMS automatically inserts pseudo waypoints at the appropriate point in the flight plan on these lines, (e.g., T/C, S/D, T/D, etc.



Label Lines (Routing)

The routing between waypoints is depicted in small white font between the waypoints. The lack of a specified label indicates a direct route between the waypoints. The routings can be:(ref above)

- Airways (e.g.,V24, J96)
- Courses (e.g., C124)
- Headings (e.g., H245)
- SID or STARS (e.g. JVL4)

Note: The label line associates individual waypoints with each other in a specific sequence. If a pilot modifies this sequence by adding (or deleting) a point, the associated waypoints are no longer linked and the label line will disappear.

Distance

The distance between each waypoint is displayed in nautical miles between the lines that identify them.

During an approach, this line also displays the angle of the final descent path (e.g., 2-3 degrees indicates the leg is 2NM long and the descent angle is 3 D).

Bearing and Track

The bearing between the FROM and TO waypoints is displayed as BRGXXX. It is the bearing from the aircraft's current position to the TO waypoint

The track between the two waypoints displayed adjacent to LSK 2 and LSK 3 on the MCDU menu, respectively, is displayed as TRK XXX. This track is displayed between ant two waypoints, including a pseudo waypoint, by scrolling the fight plan to place the referenced waypoints adjacent to LSK 2 and LSK 3 on the MCDU. The track displayed is the outbound track from the first of the two waypoints.

Constraint Symbol

A Constraint symbol (*) is displayed in magenta or amber at waypoints with an associated speed limit, speed, altitude, and UTC constraints.

The constraint symbol is:

- Magenta, when the constraint is predicted to be met
- Amber, when the constraint is predicted to be missed

The value depicted in green adjacent to this symbol is the predicted airspeed or altitude at that waypoint. It is not necessarily the value of the constraint.

Flight Plan Pages (continued)

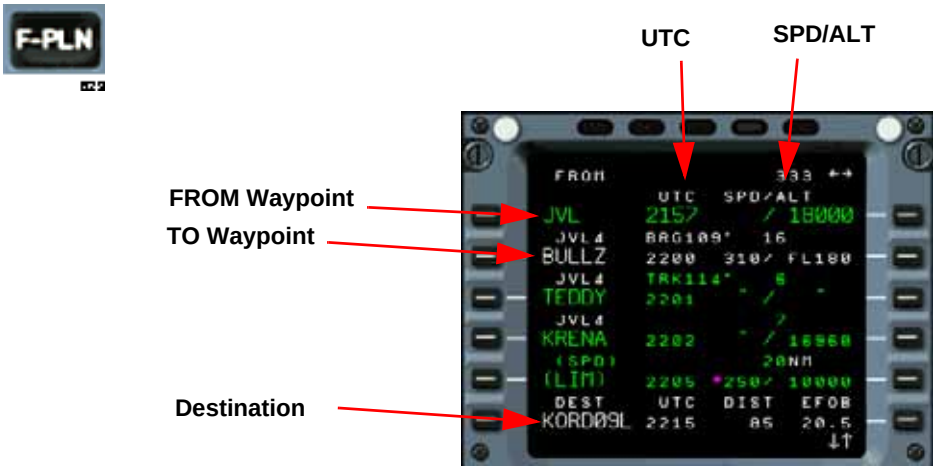
DEST

The flight plan DEST line displays the ICAO identifier for the destination airport, (e.g., KMSP). After an arrival runway is inserted, the ICAO identifier plus the selected runway is displayed, (e.g., KMSP30L). The UTC time of arrival, distance (DIST), and Estimated Fuel On Board (EFOB) are displayed based on predictions following the active flight routing, entered winds, etc.

Flight Plan Page A

General

In addition to the data fields previously presented under Flight Plan Pages, flight plan page A provides time, speed, and altitude information.



Title Line

The title line consists of the:

- Flight number as inserted on INIT A
- FROM waypoint title, (when at the top of the flight plan)
- The predicted time of arrival (UTC) title
- The predicted speed and altitude (SPD/ALT) at each waypoint

TIME/UTC

The time at which the aircraft passed the from waypoint is displayed in the center field on the FROM waypoint line.

The predicted ETA at each subsequent way point is displayed in the center field.

Prior to takeoff, the field label is TIME and the values reflect the time from takeoff until reaching the waypoint. After takeoff the field label is UTC and reflects the ETA at the waypoint.

Flight Plan Page A (continued)

SPD/ALT

The predicted speed and altitude at each waypoint is displayed. The displayed speed is normally the FMS managed speed, unless limited by a speed limit or speed constraint.

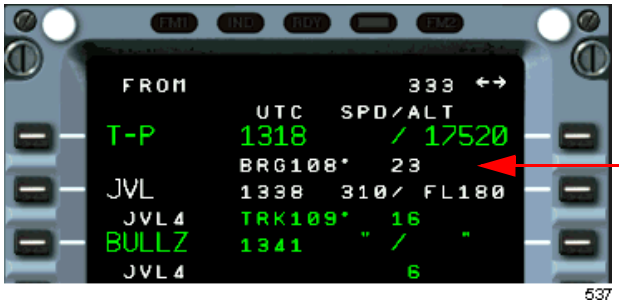
The predicted altitude at each waypoint is displayed. It is computed using the current aircraft vertical flight guidance mode, aircraft performance database and any altitude constraints. This field is useful in monitoring crossing restrictions during a STAR, for example, and displays the predicted altitude at each waypoint based on current and planned conditions.

If the FCU altitude reference is barometric, the predicted altitude is displayed in feet (rounded to the nearest 100 feet). If the FCU altitude reference is STD, the altitude is displayed in flight levels.

Note: Vertical predictions are only accurate when wind data (climb, cruise, and descent) have been entered into the MCDU

Distance

The distance between waypoints is depicted in nautical miles.

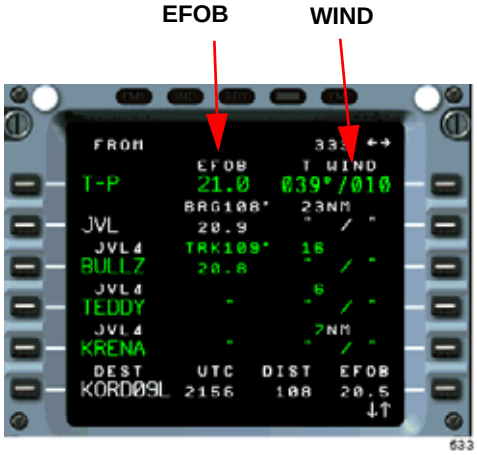


F-PLN Page B

Description

The F-PLN page B is accessed from the F-PLN page A by depressing either NEXT PAGE key. The F-PLN page B is identical to page A except that at each waypoint:

- the center column is now Estimated Fuel On Board (EFOB), and
- the right-hand column is actual ADIRU wind (at the FROM waypoint). At all other waypoints it is pilot entered winds or predicted winds (if no pilot entry was made).



EFOB

The EFOB (Estimated Fuel On Board) field displays the predicted fuel remaining at each waypoint. It is computed along the flight plan route, using forecast and actual winds.

The EFOB at the FROM waypoint is the actual fuel recorded when passing that point.

T WIND

The T WIND (True Wind) value at the FROM waypoint is the actual wind measured by the IRU when the FROM waypoint is sequenced.

The T WIND field at all other waypoints display the predicted wind at each waypoint relative to true north.

If the wind direction and/or speed of one leg is predicted to be equal to the wind direction and/or speed of the previous field, then a ditto (“) is displayed instead.

Predicted wind values are based on wind entries made on the CLIMB, CRZ, and DESCENT WIND pages. Winds cannot be changed or entered on F-PLN page B.

Wind values displayed on the flight plan page may be:

- Manually entered wind values (if the predicted altitude for the waypoint matches the wind entry altitude at the waypoint)
- Interpolated values, when the predicted wind at the waypoint fall between manually entered values
- Extrapolated wind values, when the cruise altitude is higher or lower than the highest or lowest manually entered cruise wind values the closest available wind is used.

LAT REV Page

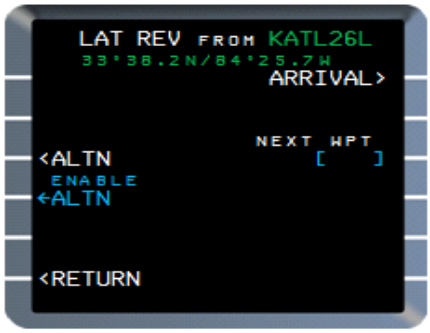
Description

Lateral revisions (LAT REV) are changes made in the lateral flight plan from a specific waypoint. This waypoint is called the revised waypoint, which may be any point in the flight plan, including the FROM waypoint, enroute waypoint, departure airport and destination airport.

Revisions only affect the flight plan from that point. All previous flight plan routings remain the same.

The LAT REV page is accessed by selecting the Left LSK from any waypoint on either F-PLN page A or B. The options available on the page vary with the waypoint selected.

Lateral revision from departure airport



Lateral revision from destination airport

Lateral revision from PPOS (From waypoint)

Lateral revision from an enroute waypoint

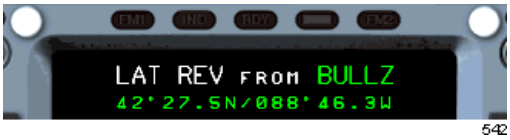
Changes made to the active flight plan via the LAT REV page will produce a temporary flight plan. This will display on both the flight plan page and the ND, and may be entered or erased. Lateral revisions to the secondary flight plan do not produce a temporary flight plan.

Note: Predictions are not provided for temporary flight plans.

LAT REV Page (continued)

Title Line

The title line displays the name of the revised waypoint and the latitude and longitude of that point, with the exception of the lateral revision from the PPOS.



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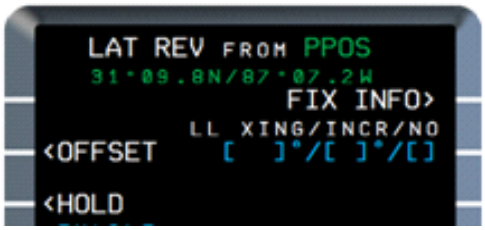
DEPARTURE

The DEPARTURE prompt displays the DEPARTURE pages, allowing the selection of departure runways and SIDs. The DEPARTURE prompt is only displayed on the LAT REV page when selected from the departure airport.

OFFSET

The OFFSET prompt is only displayed at a LAT REV from the FROM waypoint and is not available while on a direct-to leg.

It allows entry or deletion of a parallel course (e.g., an OFFSET) to the flight plan routing.



HOLD

The HOLD prompt allows the pilot to create or modify a holding pattern at the selected waypoint.

If the LAT REV was done at LSK 1 (the FROM waypoint), the holding pattern is created at the aircraft's present position (e.g., a PPOS hold). (Ref above)

ENABLE ALTN

The enable alternate (ENABLE ALTN) prompt provides access to the alternate flight plan and creates a temporary flight plan to the alternate. If selected, the flight plan proceeds from the selected waypoint to the destination and then to the alternate airport.

The ENABLE ALTN prompt is only displayed when an alternate airport is in the active flight plan.

LAT REV Page (continued)

ALTN

The ALTN prompt is only displayed at a LAT REV from the destination. It provides access to a database list of alternates (if available) and allows the pilot to change the selected alternate and evaluate different alternates.

RETURN

The RETURN prompt displays the previously selected F-PLN page.

ARRIVAL

The ARRIVAL prompt is only displayed at a LAT REV from the destination. Either the destination displayed at 6L on the F-PLN page or the destination line at the end of the flight plan can be used. This prompt accesses the ARRIVAL pages, allowing the pilot to select STARS, instrument approaches and arrival runways. Refer to Flight Plan Entry, discussed later in this section.

The ARRIVAL prompt will not be displayed when laterally revising the flight plan from the destination if the destination airport is the active TO waypoint. To obtain an ARRIVAL prompt, select HDG on the FCU.

FIX INFO

The RADIAL FIX INFO prompt displays the RADIAL FIX INFO PAGE 1. The purpose of the FIX INFO is to provide supplementary navigational information for up to four reference points.

LL XING / INCR / NO

The LL XING/INCR/NO prompt allows inserting of a LAT or LONG crossing point at specific intervals of latitude or longitude.

NEXT WPT

The next waypoint (NEXT WPT) field specifies the waypoint to follow the currently referenced waypoint. This provides for eliminating waypoints that are no longer required. It can also be used for initial flight plan entry.

Example: If on an airway and given a clearance “AFTER XYZ proceed direct to ABC” a LAT REV is accomplished at XYZ. ABC is entered at the NEXT WPT field, and any intervening waypoints between XYZ and ABC are deleted.

LAT REV Page (continued)

NEW DEST

The new destination (NEW DEST) field is displayed at all LAT REVs except at the destination and the FROM waypoint. It allows the pilot to change the flight plan destination. A four letter ICAO identifier (e.g., KDTW) is required. Inserting the new destination will eliminate all waypoints beyond that point. (Ref above)

AIRWAYS

The AIRWAYS prompt displays the AIRWAYS page.(Ref above)

TMPY ERASE

The TMPY ERASE prompt is displayed if a temporary flight plan exists. Selecting TMPY ERASE deletes the temporary flight plan and returns you to the active flight plan. The TMPY ERASE is also displayed on the flight plan page.

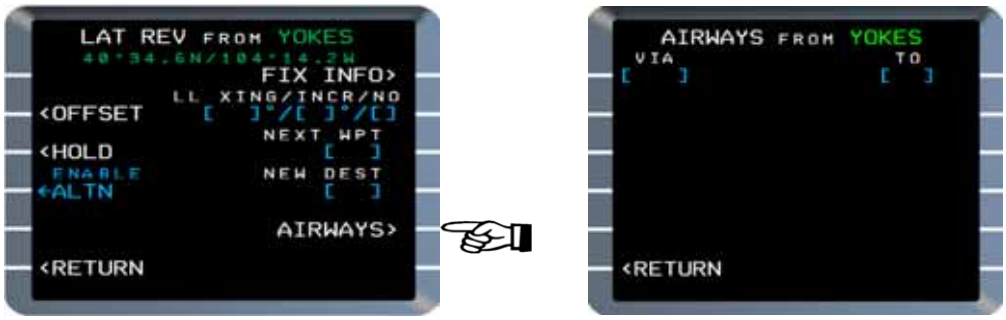
TMPY INSERT

The TMPY INSERT prompt is displayed if a temporary flight plan exists. Selecting TMPY INSERT activates the temporary flight plan and returns the display to the active flight plan page. The TMPY INSERT prompt is also displayed on the flight plan page.(Ref above)

LAT REV Page - AIRWAYS Page

General

The AIRWAYS page allows entry of up to five route segments defined by airway name into the flight plan at one time. The page is used only to insert new airway segments into the flight plan, currently inserted airways are not shown on the page. When an airway segment is defined on the AIRWAYS page, a temporary flight plan is created.



Title

The title line displays AIRWAYS FROM and the name of the waypoint from which the defined airway segments will begin. This is the same waypoint referenced on the selected LAT REV page.

VIA

The VIA field accepts airway names. The VIA field must be entered prior to other fields appearing (e.g. J154, V207, UJ15, etc.).

TO

The TO field is the ending point on the airway that is in the VIA field (e.g. BAE, DUNKS, etc.).

TMPY ERASE

The TMPY ERASE prompt is displayed if a temporary flight plan exists. Selecting TMPY ERASE deletes the temporary flight plan and returns you to the active flight plan. The TMPY ERASE is also displayed on the flight plan page.

TMPY INSERT

The TMPY INSERT prompt is displayed if a temporary flight plan exists. Selecting TMPY INSERT activates the temporary flight plan and returns the display to the active flight plan page. The TMPY INSERT prompt is also displayed on the flight plan page.

VERT REV Page

Description

A VERT REV (vertical revision) is a change made in the vertical flight plan at a specific waypoint. This waypoint is called the revised waypoint. It may be any point in the flight plan, including the FROM waypoint, down-track waypoint, departure and destination waypoints, and the SPDLIM waypoint. The SPDLIM pseudo waypoint is the only pseudo waypoint that will allow a vertical revision.

Revisions only affect the flight plan from that point.

Vertical revisions include:

- Speed limit
- Speed constraint
- Altitude constraints
- Wind page selection
- Step Altitudes page selection

The vertical revision page is accessed from the F-PLN pages A or B by selecting a right LSK (the scratchpad must be empty).

It is important to select the correct right LSK, as the vertical revision is inserted into the flight plan at the waypoint corresponding to the LSK selected.

Vertical revision page from departure airport

Vertical revision page from destination airport

Vertical revision page from a waypoint

Vertical revision page from SPDLIM

VERT REV Page (continued)

Title Line

The title line displays the VERT REV AT and the name of the revised waypoint. Also in the title line is the EFOB at that waypoint and EXTRA fuel at that waypoint.

Note: EXTRA fuel is the remaining fuel after all other flight plan fuel has been consumed. Taxi, flight plan fuel burn, reserves (RTE RSV), the predicted fuel burn to the alternate, and final (holding) fuel are subtracted from current fuel. Refer to the discussion for INIT page B for a complete discussion of fuel planning.

CLB (DES) SPD LIM

The CLB SPD LIMIT or DES SPD LIM field displays the speed limit and corresponding altitude applicable to the climb or descent phase.

The values are displayed in small font when the data comes form the database, and large font when manually enter. Both are in magenta. The default value is 250 KIAS/10,000 feet. The speed limit is always associated with an altitude.

SPD CSTR

A SPD CSTR field displays the speed constraint associated with the selected waypoint. The values are displayed in small font when the data comes from the database, and large font when manually entered. It can be entered only in KIAS. A speed constraint can be deleted by entering CLR in this field.

SPD CSTR is not displayed at the departure or destination airports, the FROM waypoint, or a speed limit pseudo waypoint.

CONSTANT MACH

The CONSTANT MACH prompt displays the CONSTANT MACH page. This function enables a constant mach cruise segment to be define between two flight plan waypoints.

WIND DATA

The ACCESS WIND DATA prompt displays the WIND pages. The first WIND page displayed corresponds to the flight phase for the selected waypoint (e.g., if the selected waypoint occurs during the cruise phase, the CRUISE WIND page is displayed.)

RETURN

This prompt reselects the previous F-PLN page.

VERT REV Page (continued)

ALT CSTR

An ALT CSTR field displays the altitude constraint assigned to this waypoint. The value is magenta. A large font indicates the value has been manually entered (either on this page or directly on the FLIGHT PLAN page), and a small font indicates the constraint is stored in the database.

Manually entered altitude constraint

Inserting the constraint whether on the vertical revision page or directly on the flight plan page will bring up a temporary flight plan. The temporary will then have to be INSERTed or ERASEd.

Clearing the field on the VERT REV page deletes the constraint and displays blue brackets.

Flight levels are entered using three or fewer digits (FL may proceed the entry, but is optional). MSL altitudes are entered using four or five digits, with leading zeros if required. For example:

- FL350 or 350 = FL350
- FL35 or 35 = FL035 (3500 feet)
- 3500 = 3500 feet MSL
- 0350 = 350 feet MSL

Altitude constraints can be entered using the following formats.

- Cross at: XXXXX (e.g., 180 or FL 180 for FL180)
- Cross XXXXX at or above: (e.g., +17000)
- Cross XXXX at or below: (e.g., -9000)

A window constraint may be displayed, which defines two altitudes that the aircraft must fly between. A WINDOW constraint cannot be manually entered and is only inserted as part of a database procedure (e.g., STAR).

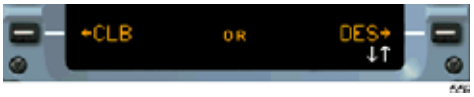
Flight Plan in preflight phase

Altitude constraint window

VERT REV Page (continued)

CLB or DES

Amber CLB and DES prompts are displayed on line 6 when the FMS cannot determine if the entered vertical constraint should occur in the climb or descent phases.



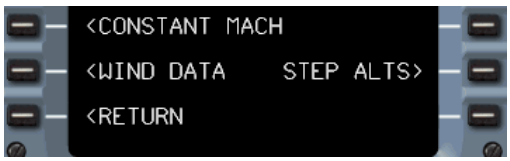
If a constraint is entered at a cruise phase waypoint or before the top-of-climb and top-of-descent predictions are computed the FMS needs to know if the new constraint is to be applied to the climb or descent phase.

If neither choice is desired (i.e., to cancel the constraint altitude entry without making a selection) select any other page key.

Note: If the altitude constraint was entered on the flight plan page, the CLB or DES prompts are displayed on the bottom of the flight plan page.

STEP ALTS

The step altitudes (STEP ALTS) prompt allows the pilot to enter or modify a flight plan FMS.



A step climb (or descent) allows the pilot to evaluate the fuel and time variations as a result of a change in altitude. A different wind can be entered at the anticipated step altitude.

The S/C or S/D can be deleted from the flight plan by clearing the pseudo waypoint in the flight plan.

Step altitudes can be inserted at a geographic location as per the Worldflight flight plan, or by using the Optimum Step feature of the FMS.

ALT ERROR

This ALT ERROR field displays the difference between an altitude constraint and the predicted altitude when the constraint is predicted to be missed. This field only applies to waypoints in the climb and descent phases.

560

A “-” indicates that the aircraft will be below the constraint altitude at the waypoint: a “+” indicates that the aircraft will be above the constraint altitude.

Note: The VDEV field on the PROG page depicts the current difference between the aircraft's computed descent path and the current altitude. A VDEV on the PROG page does not necessarily indicate that an altitude error will occur at the next waypoint.

VERT REV Page (continued)

RTA

The RTA (Required Time of Arrival) function enables:

- An estimated takeoff time.
- A RTA at a specific waypoint
- A RTA at your destination

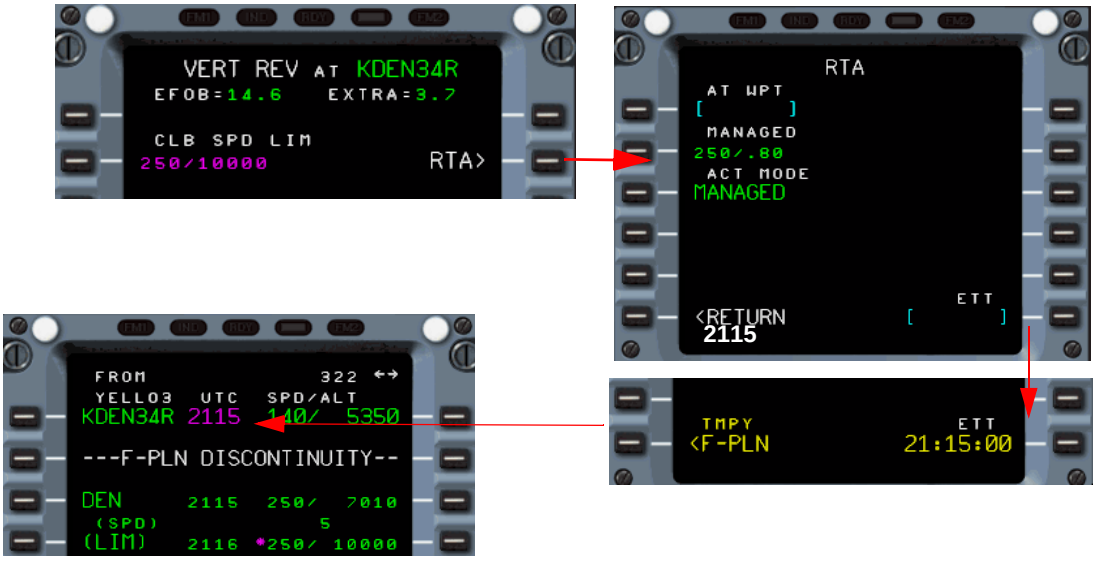
The general rules for using a RTA are as follows;

- Only one RTA may exist in a F-PLN, creation of a second such entry will cause deletion of the first.
- The RTA is rejected with NOT ALLOWED in the scratchpad in the following cases:
  - ENG OUT mode active
  - No valid clock data
  - A/C is decelerating to, or in a hold
  - Active flight phase is GO-AROUND
  - Active flight phase is DESC or APPR, and current ALT is at or below SPD LIM altitude
  - Entered RTA is more than 20 hours after clock time

RTA predictions are “Missed” at a waypoint if difference between ETA at the waypoint and RTA exceeds the “Time Tolerance” which depends on distance of time constraint waypoint from aircraft position.

Estimated Takeoff UTC Time

An estimated takeoff time (ETT) can be entered by performing a VERT REV at the departure airport prior to takeoff. Then selecting the RTA prompt at 2R. An ETT UTC time constraint (UTC CSTR) can be entered at 2R.



ETT on flight plan page

VERT REV Page (continued)

Estimated Takeoff UTC Time (continued)

The ETT is displayed in large magenta font as the UTC time on the F-PLN page A at the FROM waypoint. When the ETT is reached, the message CLK IS TAKEOFF TIME (The clock is takeoff time) is displayed. After this time, the aircraft clock time is displayed in this field.

After takeoff, the UTC time on this line is the actual takeoff time.

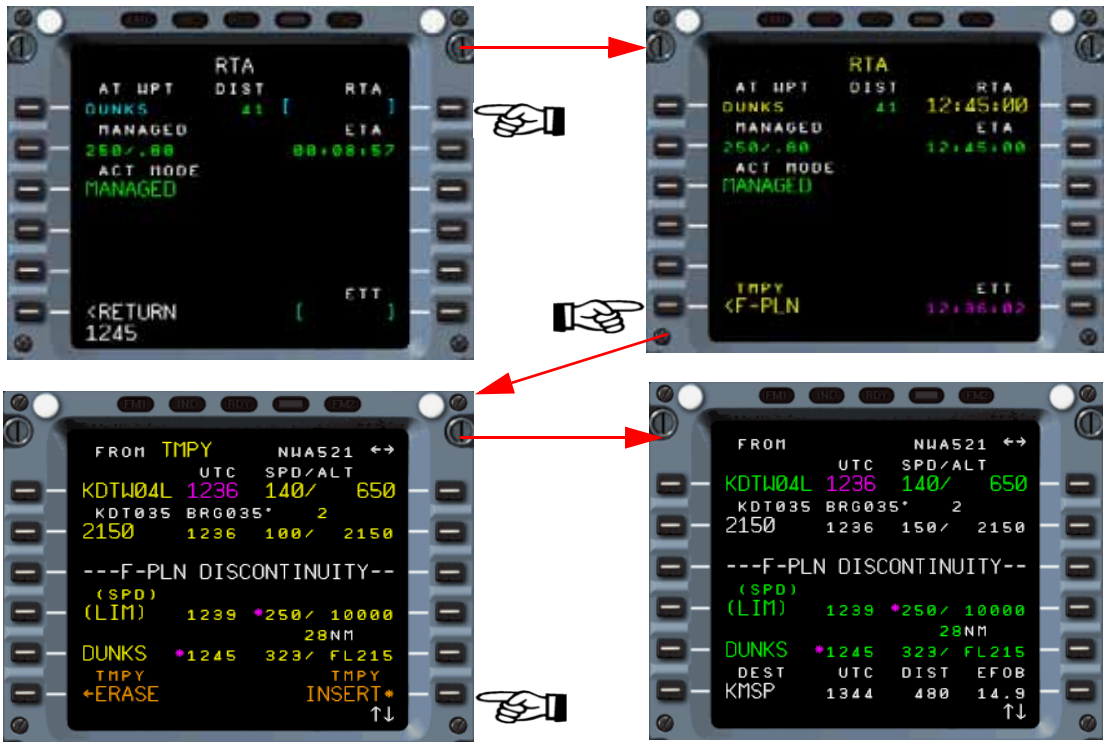
RTA at F-Plan Waypoint

If RTA is accessed from VERT REV at a waypoint belonging to the F-PLN during preflight;

- AT WPT displays ident of the revised point
- DIST shows distance from actual position to the WPT along the ACTIVE F-PLN
- RTA (1R) displays brackets, enabling entry of a RTA
- ACT MODE (3L) displays active speed mode with associated soeed in (2L)
- ETA (2R)displays time to selected WPT
- ETT (6R) displays brackets, enabling the entry of ETT

RTA at F-Plan Waypoint (continued)

To enter a RTA during preflight, access the VERT REV page by right LSK at the desired waypoint, then enter the desired time in LSK1R. This will create a TMPY flight plan and will also create a ETT. The ETT can be modified if desired. (Example below.)



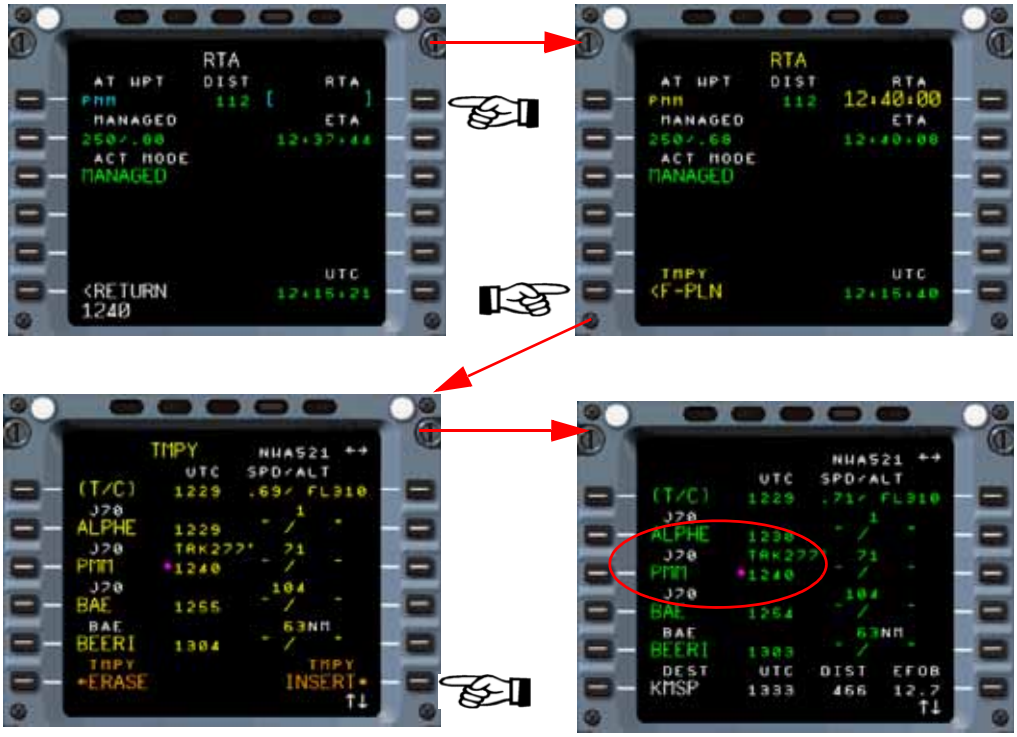
VERT REV Page (continued)

RTA at Destination

To enter a RTA during for your destination, access the VERT REV page by right LSK at the destination. The procedures are the same as the above example. The F-PLN will indicate the RTA with an asterick and actual time of arrival.

RTA at F-Plan Waypoint

To enter a RTA during flight, access the VERT REV page by right LSK at the desired waypoint, then enter the desired time in LSK1R. This will create a TMPY flight plan.



VERT REV Page (continued)

Vertical Revision At Destination

A VERT REV at the destination with an ILS approach selected, depicts the altitude of which the glideslope intersects the runway. This field (G/S INTCPT) is not displayed without an ILS approach selected or when any other type of approach is selected.

Lateral Flight Plan Entry

Entry Sequence

The lateral flight plan waypoints (navigation routing) must be entered before the corresponding vertical flight plan information can be entered. Vertical flight plan information (altitude constraints, speed constraints and wind information) must be entered at specific waypoints in the lateral flight plan.

Flight Plan Colors

Waypoints in the displayed flight plan are divided into four color groups:

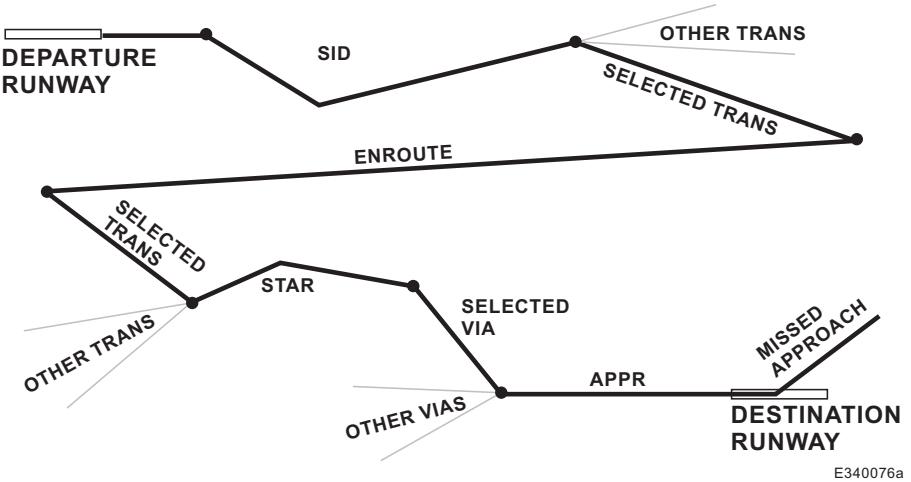
- Green - waypoints between the departure and destination airports
- White - the TO waypoint and F-PLN DISCONTINUITY
- Yellow - the temporary flight plan
- Blue - the TO waypoint if it is a tuned VOR or any waypoints or routing entered after the destination airport

Note: On the ND, the missed approach routing is a solid blue line. The routing to an alternate airport is normally dashed blue. Once an alternate has been “enabled” it becomes the destination in the flight plan (refer to Alternate Airports, discussed later) and is displayed in green.

Lateral Flight Plan

The lateral flight plan is made up of the following segments and points:

- The departure airport and runway
- Departure procedures (SIDs with associated transitions)
- Enroute routing
- Arrival procedures (STARs with associated transitions)
- Approach procedures (with associated vias)
- The destination airport and runway.



After the entry of the departure and destination airports, flight plan segments can be entered or modified in any order.

Lateral Flight Plan Entry (continued)

F-PLN Discontinuity

When a segment is not connected to the previous segment, a flight plan discontinuity (F-PLN DISCONTINUITY) is automatically entered into the flight plan. The discontinuity indicates that the route between the two waypoints is not defined

The automatic insertion of discontinuities prevents an unintentional direct routing between waypoints that would occur if the waypoints were not separated by a discontinuity.

If the aircraft reaches the F-PLN DISCONTINUITY in managed lateral mode, the heading or track mode automatically engages and the aircraft maintains its current heading or track. An amber LAT DISCONT AHEAD message is displayed when the aircraft reaches 30 seconds from the F-PLN DISCONTINUITY.

Note: The selection of heading or track depends on the selection of the HDG V/S - TRK FPA pb on the FCU.

A F-PLN DISCONTINUITY is entered into the flight plan:

- After entering a new waypoint (or airway segment)
- After selecting a departure runway without a SID
- Prior to the first waypoint of an instrument approach procedure. The discontinuity is not entered if the instrument approach procedure is connected to the existing flight plan through the selection of an APPR VIA on the arrival page.

Segments can be connected by clearing the F-PLN DISCONTINUITY.

Lateral Flight Plan Entry (continued)

Pseudo Waypoints

The FMS creates waypoints along the flight plan where certain actions are predicted to occur. These waypoints are called “pseudo” waypoints. The pseudo waypoints increase pilot awareness of FMS predictions and actions. A change in aircraft speed, altitude, and/or thrust occurs as a pseudo waypoint is sequenced.

Pseudo waypoints are displayed on the MCDU flight plan page in the order in which they are predicted to occur. In the example below, the aircraft is predicted to pass 10,000 feet MSL (and the speed limit at 10,000) 1 nm after OBK. The Top of Climb (T/C) pseudo waypoint is predicted to occur between OBK and BAE.

The pseudo waypoints will move as necessary if the predicted order changes.

Lateral Flight Plan Entry (continued)

Pseudo Waypoints (continued)

Pseudo waypoints correspond to ND symbols. Pseudo waypoints are not displayed during FMS calculations.

The pilot cannot create a pseudo waypoint. Speed or altitude constraints cannot be inserted at pseudo waypoints, although speed and/or altitudes can be modified through a vertical revision at the SPDLIM pseudo waypoint. It is not necessary to delete pseudo waypoints from the MCDU flight plan when a flight plan reroute has occurred, as they will automatically move or delete as necessary. Pseudo waypoints should be ignored when entering or modifying flight plans.

Note: Deleting a speed limit pseudo waypoint deletes the limit from the flight plan and allows the aircraft to exceed the speed limit.

Pseudo waypoints are summarized in the following table:

MCDU Symbol	Pseudo Waypoint	Definition
(T/C)	Top of Climb	The FMS calculated point where the aircraft will reach the cruise altitude or a step altitude if in a step climb
(T/D)	Top of Descent	The FMS calculated point where the aircraft will reach the top of the computed descent path
(S/C)	Step Climb Point	Pilot inserted step climb point
(S/D)	Step Descent Point	Pilot inserted step descent point
(LIM)	Speed Limit	The speed limit and associated altitude as entered in the flight plan (default value 250 KIAS/10,000 ft MSL)
(DECEL)	Deceleration Point	The point at which the FMS approach phase automatically activates and the aircraft automatically decelerates in NAV mode

Lateral Flight Plan Entry (continued)

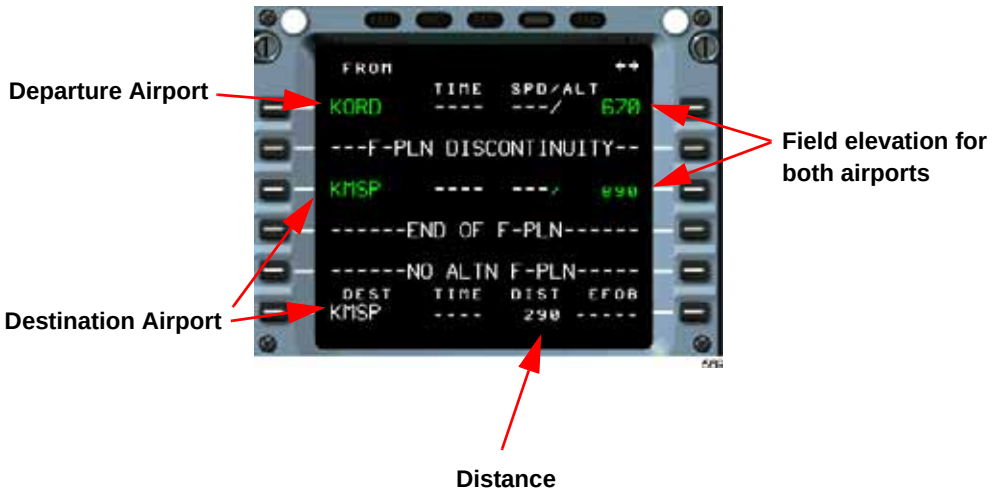
Flight Plan Initialization

The flight plan is initialized when the departure and destination airport identifiers is entered on INIT page A or uplinked to the aircraft.

Note: Delta databases do not include CO RTES. However, a CO RTE procedure can be used to enter a flight plan if the pilot had previously stored the route as discussed in this section on the STORED PILOT ROUTES page.

For example, KORD/KMSP was entered on INIT page A. The F-PLN page A now displays:

- The departure airport identifier in green
- The direct distance between the two airports
- The field elevations of both airports
- The destination airport identifier in green and in white



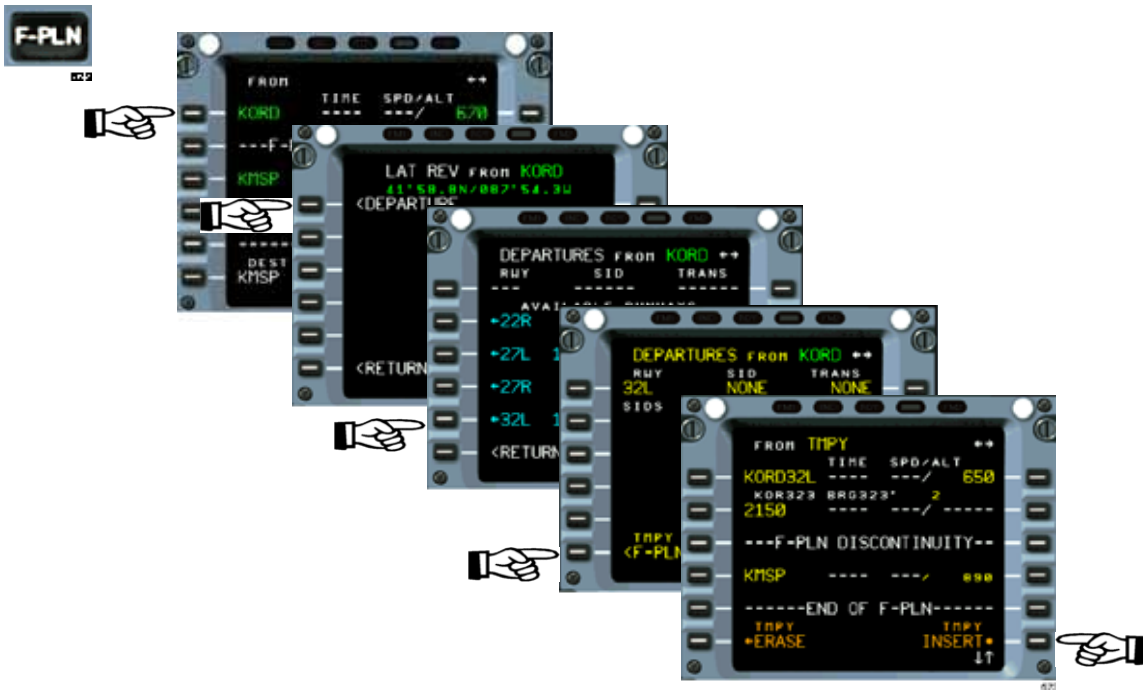
Lateral Flight Plan Entry (continued)

Departure Runway Entry

Once the departure airport has been entered, the departure runway can be selected. If the takeoff runway is not known during preflight, this step can be delayed until the takeoff runway is known.

Note: If a takeoff runway has been entered in the flight plan, the FMS position is updated during takeoff. An error in takeoff runway selection incorrectly updates the FMS position. (Note: N/A GPS equipped aircraft).

The list of available database runways is accessed by performing a LAT REV from the departure airport as shown below.



Runway description on the departure page includes the following elements:

- The runway identifier including left, center, or right (L, C, R) if applicable,
- Available runway length
- Runway magnetic heading
- ILS identifier and frequency (if available)

The slew arrows (if present in the lower right corner of the display) indicates that additional runways can be displayed by scrolling.

Lateral Flight Plan Entry (continued)

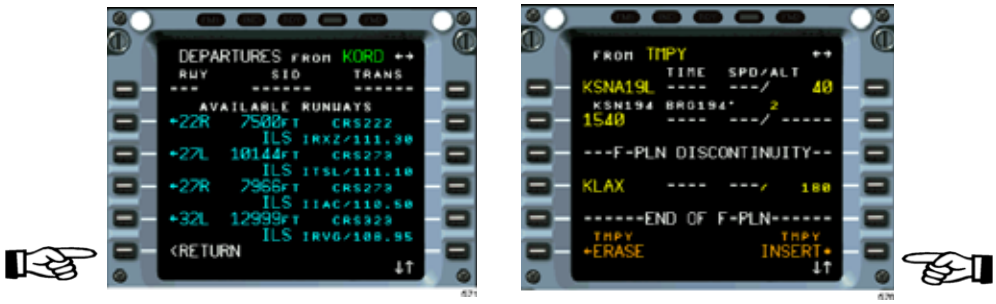
Runway Entry (continued)

If the desired runway is not listed, the NEW RUNWAY data page can be used to enter the runway.

A runway is selected by pressing the left LSK adjacent to the desired runway. A previously selected runway is displayed in green without an arrow, and displayed at 1L in green. Other database runways are displayed in blue.

Once the runway has been selected, a temporary flight plan is created, and the selected runway in displayed in yellow in the runway (RWY) field at 1L. A list of available SIDs is automatically presented after runway selection. The desired SID can be selected at this point, or entered later.

The field at 1L displays the selected runway which will be inserted into the flight plan when the TMPY F-PLN prompt is selected. The fields at 1C and 1R display the selected SID and TRANS that will be inserted (discussed next). These fields must be reviewed before inserting the runway to ensure that the correct procedure is being inserted. In the example below, no SID or TRANS has been selected and NONE is listed in these fields.



The pilot must select the TMPY F-PLN prompt before ANY other flight planning actions are allowed, (except SID / TRANS selection).

When the TMPY F-PLN prompt is selected, the runway is inserted into the flight plan, and the display returns to the temporary flight plan page.

Note: Altitude and speed constraints entered by the pilot on a SID are automatically erased each time the SID is inserted into the flight plan. This will occur if pilot entered altitude or speed constraints were made to a SID prior to runway selection.

Lateral Flight Plan Entry (continued)

Runway Entry (continued)

When the runway is inserted, the F-PLN page A is automatically displayed, with the selected runway information in line 1. The runway is also displayed on the ND.

The runway information includes the runway heading and a conditional waypoint after takeoff. The default for this conditional waypoint is defined by an altitude 1500 feet above the runway. In the example above for runway 19R at KSNA, this waypoint is 1540 (MSL) on the runway heading of 194 degrees. This conditional waypoint automatically sequences when the aircraft climbs through this altitude.

Selecting a SID may modify or delete this conditional waypoint, as appropriate.

Lateral Flight Plan Entry (continued)

SID Entry

A SID can be entered into the flight plan before or after the runway selection. Following a runway selection, the list of SIDs is automatically displayed.

Note: SIDs and STARs that contain runway specific routes (i.e., portions that are not common to all runways) require the runway selection to provide the full procedure for the desired runway. If a SID or STAR is entered without a runway selection, only the common portion is entered. In some cases this may result in no waypoints being inserted into the flight plan until the runway is also selected.

If a transition is not available after SID selection, NONE appears in the TRANS field at 1R.

In the example below, the SID is being entered into the flight plan during preflight planning and does not have any available transitions.

Lateral Flight Plan Entry (continued)

SID Entry (continued)

In the next example, the BCKBY2 departure has been selected, the IPL and TRM transitions are available for selection as well as a no transition option (NO TRANS). In this case the TRM transition has been selected, but not yet inserted. Also in this example, runway 19R had been selected before the SID and TRANS were selected.

As the SID and transition selections are made, a temporary flight plan is created. The temporary flight plan may be reviewed on the ND and flight plan page before TMPY INSERT is selected.

Selecting a departure runway automatically enters the runway unique portions of the SID. In some cases such as the BCKBY2 departure (example below), a continuous routing from the runway, throughout the SID is inserted into the flight plan.

In the case of the SNINE departure at KMSP, (which is a initially a vector departure), the routing is also direct to the first fix in the database departure procedure. In this case, a flight plan discontinuity (F-PLN DISCONTINUITY) should be added after the runway in the flight plan.

Caution: *The SID is not properly connected to the departure airport until a departure airport runway is selected. Entering a SID without a departure airport runway will create a direct routing from the airport field in line 1L to the first point on the flight plan. Most times this is incorrect as inserting the departure airport runway into the flight plan may add additional waypoints to the flight plan.*

Lateral Flight Plan Entry (continued)

Engine Out SID

If the database contains an Engine Out SID (EO SID) for the selected runway, it is automatically selected when the departure runway is selected. It may be previewed on the ND using the PLAN mode

An EO SID can be manually inserted as the departure SID in the active or secondary flight plan if selected from the list of available SIDs.

For each EO SID, an EO SID diversion waypoint is defined in the database. This diversion waypoint is the last point common to both the EO SID and the selected departure procedure (SID). If the engine failure occurs before the diversion waypoint, the EO SID is automatically presented as a temporary flight plan, and can be inserted or erased as desired.

If the engine failure occurs after the diversion point, the normal SID remains in the flight plan and no automatic action takes place.

Example is shown below.

After an engine failure, the EO SID (by selecting the TMPY INSERT prompt) automatically erases the original flight plan and changes the destination to the departure airfield.

EO SIDs are not available during a go-around.

For additional information on engine out operations, see Engine Out Operations in the Performance Optimization section of this chapter.

Lateral Flight Plan Entry (continued)

NAV MODE ARMING

When a runway and SID selection creates a continuous routing from the runway to the flight plan, the managed NAV mode can be used to fly the entire lateral profile automatically. The NAV mode engages automatically shortly after liftoff and provides automatic lateral guidance to the entire SID procedure.

When the heading is preset prior to takeoff, NAV mode disarms. The heading knob will have to be pushed to arm or engage managed NAV.

Constraint Entry

Published altitude and speed constraints on the SID (e.g., “cross ABC at 12,000 and 240 KIAS”) are coded as part of the database procedure and are automatically entered when the selected procedure is entered.

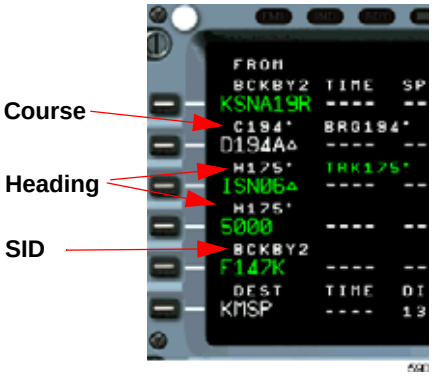
Published constraints which are “expected” clearances (e.g., expect to cross ABC at 12,000’”) are not coded with the procedure, must be entered into the flight plan manually if the constraint is to be honored.

Routing Display

The routing displayed on the flight plan pages includes:

- The waypoints and pseudo waypoints that make up the route (displayed in large green font).
- Label Lines: Track, courses, and headings, or the name of the SID, transition, or airway (displayed in small white font).

In the example to the right at KSNA, a course of 190° is flown from the departure runway to a DME point of 1 mile, (the D194A waypoint), then a heading of 175° is flown until the ISN06 waypoint and continues on a heading of 175° till 5000’, then a direct routing via the BCKBY2 SID to the F147K waypoint.



Lateral Flight Plan Entry (continued)

MANUAL Segments

Certain types of SIDs have heading segments. These heading segments are displayed waypoints labeled MANUAL in the flight plan. The autoflight system will turn to the heading (e.g. H120 label line) or track (e.g. T180 label line) specified in the MANUAL segment. Once established, this manual segment can be cleared by selecting heading or a direct routing.

MANUAL Segment

En Route

The enroute segment of the flight plan begins with the sequencing of the last waypoint on the SID or SID TRANS, or with the first waypoint after the runway without a SID entry. En route segments are either direct legs between waypoints or airways (jet or victor routes).

Lateral Flight Plan Entry (continued)

Waypoint Entry Types

Three general types of waypoints can be entered into the flight plan:

- A database waypoint
- A pilot-created waypoint
- Waypoints created by the FMS

A database waypoint can be any point in the database (navaid, airport, runway, etc.). If more than one database waypoint shares the same identifier, the DUPLICATE NAMES page is automatically displayed, allowing pilot selection of the desired waypoint.

If an attempt is made to enter a waypoint identifier not in the database into the flight plan, the NEW WAYPOINTS page is automatically displayed.

A pilot-created waypoint can be either a PBD, PBX, or LL. The waypoint can be entered and named on the NEW WAYPOINTS page. The NEW WAYPOINTS page also provides the waypoint entry format. If the format is known, the waypoint can be typed in the scratchpad and entered directly into the flight plan.

Entering a pilot-created waypoint into the flight plan automatically stores and names the waypoint as a PBD, PBX, or LL, as appropriate.

Waypoints created by the FMS consist of abeam waypoints, radial intercept points, airway intersections, and lat/long crossing waypoints. These are created as a result of pilot action, but the pilot generally does not have enough information to define them on the NEW WAYPOINTS page. The names for these waypoints are automatically chosen by the FMS and cannot be changed.

FMS created waypoints are not stored in the database and cannot be looked up by the DATA INDEX pages. However, their position can be verified by selecting the left LSK adjacent to the waypoint name. They also do not count against the maximum number of pilot created waypoints that can be stored at any one time. When these waypoints are sequenced in the flight plan they are deleted.

Waypoint Entry

A waypoint can be entered into the flight plan either:

- Directly
- Via a LAT REV

All flight plan modifications including waypoint entry, waypoint deletion, direct-to, etc., are initially performed on the flight plan page. Any change to the flight plan will then create a temporary flight plan, in yellow, which you can further modify, insert, or delete.

Lateral Flight Plan Entry (continued)

Waypoint Entry (continued)

Direct Entry

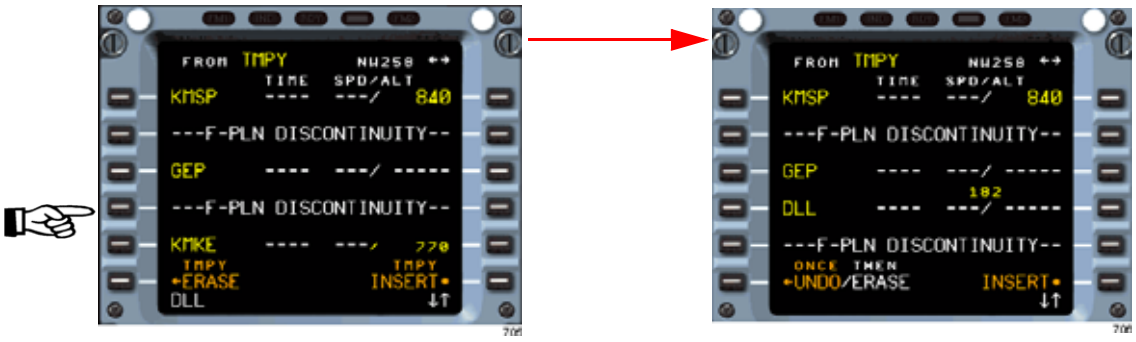
To enter a database waypoint directly into the flight plan, the waypoint identifier is first typed into the scratchpad and then the desired LSK is selected. A pilot created waypoint can be entered directly into the flight plan by typing the waypoint description (PBD, PBX, or LL) into the scratchpad and depressing the desired LSK.

The first waypoint of a flight from KMSP to KMKE is entered as shown below:

GEP enter into F-PLN

Entry shows TMPY F-PLN

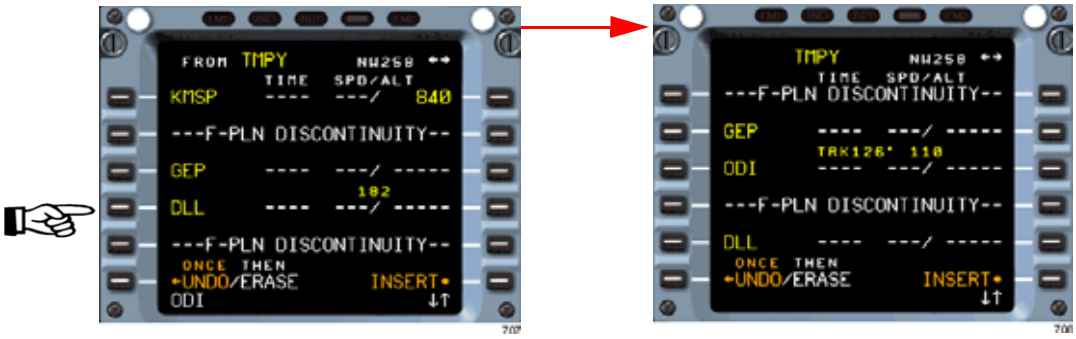
Entering a waypoint after an existing waypoint is accomplished by inserted the waypoint at the left LSK directly below the previous waypoint.



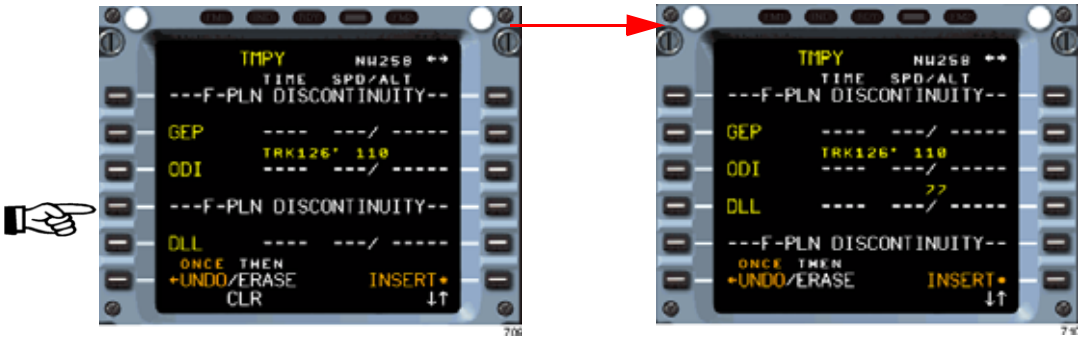
Lateral Flight Plan Entry (continued)

Waypoint Entry (continued)

Continuing to work in the TMPY F-PLN, to enter a waypoint before an existing waypoint, the LSK adjacent to the existing waypoint is pressed. The new waypoint “pushes” the existing waypoints down. A F-PLN DISCONTINUITY is automatically entered after all new entries into the flight plan. In the example below, the pilot wants to enter ODI into the flight plan before DLL. ODI is entered at the LSK adjacent to DLL as shown below:



To connect the flight plan from ODI to DLL, the discontinuity must be cleared.

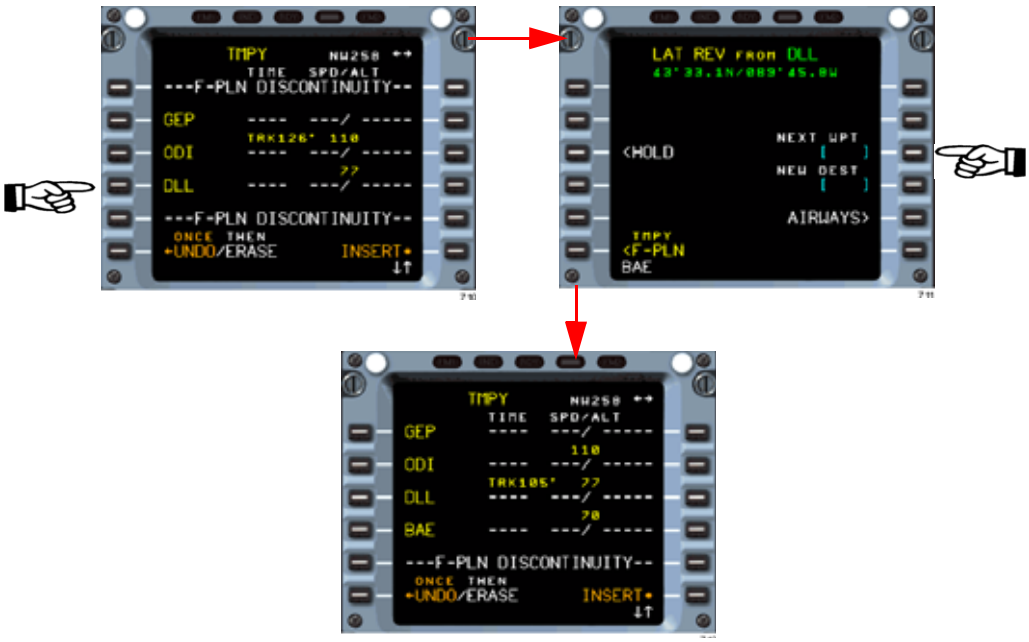


Lateral Flight Plan Entry (continued)

Waypoint Entry (continued)

LAT REV Entry

A waypoint can also be entered via a LAT REV. A LAT REV is performed at the preceding waypoint to display the LAT REV page. After displaying the LAT REV page, the new waypoint is typed into the scratchpad and then the next waypoint (NEXT WPT) prompt is selected. This method results in a yellow temporary flight plan, that must be either INSERTED or ERASED.



Entering waypoints by this method results in a direct routing between waypoints.

Note: No discontinuity is inserted when using this method.

Lateral Flight Plan Entry (continued)

Airway Entry

The enroute flight plan may also be defined by reference to airways. In the example below, (continuing an example from ODI, on the TMPY F-PLN), the following airway segments over Wisconsin will be entered:

ODI J30 SIBER J16 BAE

Airways are entered on the AIRWAYS page, which is accessed by:

- Entering the first waypoint on the airway into the flight plan (e.g., ODI)
- Selecting the LAT REV page from that waypoint
- Selecting the AIRWAYS prompt on the LAT REV page

The above example has shown the steps to insert J30 from ODI to SIBER and then J16 to BAE by inserting each waypoint that defines the airways. To simplify the process, the pilot may use the airway stringing method to have the FMS insert the TO waypoints by inserting only the airways. Refer to next example.

Lateral Flight Plan Entry (continued)

Airway Stringing

The following example will show the entry of **ODI J30 SIBER J16 BAE**, using the airway stringing method.

The first few steps of airway string are the same as the previous example

When J16 is entered into LSK2L, the FMGC inserts the correct TO waypoint from the database.

Up to five airways can be stringed together on the airways page. If the airways that are being stringed do not have a database defined waypoint, the FMGC will create the intersection. Defined by an X and then the second airway. E.g. XJ75.

Lateral Flight Plan Entry (continued)

Airway Entry (continued)

An airway is stored in the database as a sequence of waypoint identifiers. It is not possible for the pilot to modify this list of waypoints. Pilot-created waypoints that may be on the airway, but are not part of the database list for that airway, are not recognized by the FMS. The airway routing must be from a waypoint on the airway, via the airway, to a final waypoint on the airway. It is not possible to enter an airway to airway routing (e.g., J37/J107 is not allowed). If the pilot attempts to enter a waypoint/ airway combination that is not in the database, a MCDU message is displayed:

720

After entry, the airway identifier is shown as the routing between two waypoints.

721

Every waypoint on the airway between the selected waypoints is automatically entered. If the airway contains a turn point which is not named, it is listed as a VOR identifier/DME. (e.g., BAE25)

Lateral Flight Plan Entry (continued)

STAR Entry

A STAR can be entered into the flight plan before or after the arrival runway selection. The STAR entry procedure is very similar to the SID entry procedure. The STAR is normally entered during preflight, before the arrival runway is known.

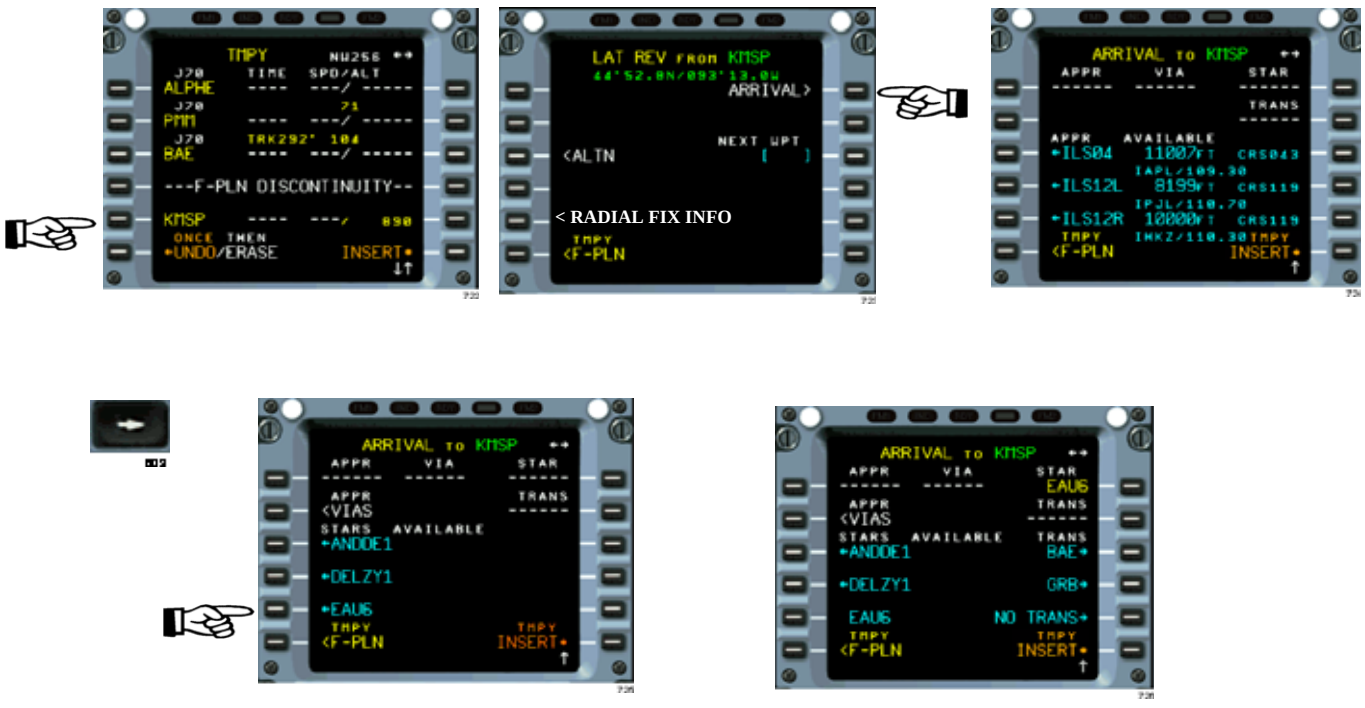
To enter a STAR into the flight plan, the ARRIVAL page must be accessed by performing a LAT REV from the destination airport. This LAT REV can be from either:

- The destination airport permanently displayed on line 6 (i.e., LSK 6L)
- The last line of the active flight plan, which displays the destination airport identifier in green.
- The last line of the TMPY flight plan, which displays the destination airport identifier in yellow.

The ARRIVAL prompt is then displayed at 1R. Selecting the ARRIVALS prompt displays the ARRIVAL page. This page displays a list of database instrument approaches and corresponding runways for that airport. Selecting a runway automatically displays the list of available STARS.

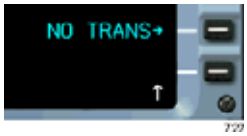
If the arrival runway is not known or has already been selected, the list of available database STARS is accessed by using the NEXT PAGE key.

The following illustration is a STAR entry on a flight plan from DTW to MSP. This illustration is also depicting that the STAR is being entered on the TMPY F-PLN page during initial flight planning



Lateral Flight Plan Entry (continued)

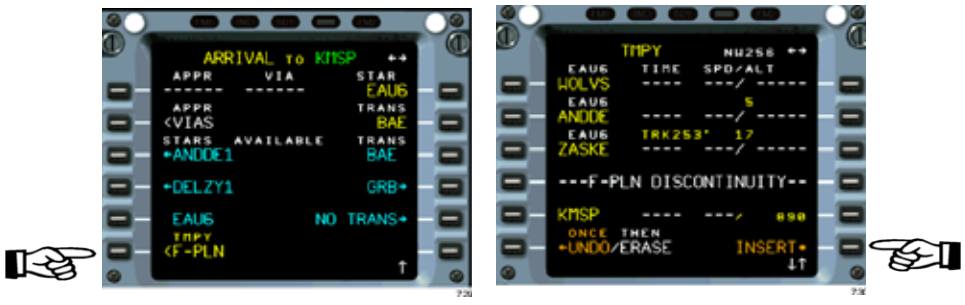
STAR Entry (continued)



The slew arrows (if present) indicate that additional STARs can be displayed by scrolling. A STAR is selected by pressing the left LSK adjacent to the desired STAR. A previously selected STAR is displayed in green without an arrow, and is displayed at 1R in green. Other available database STARs are displayed in blue with adjacent arrows. If a STAR has been previously selected, and a STAR is not desired, the NO STAR prompt should be selected.

Due to significant variations in the routings, a STAR may be listed more than once, with each variation corresponding to a different arrival runway. For example, the BARET STAR (BAR) into SAN is listed with a choice for runway 09 and a choice for runway 27, as shown below:

En route transitions (TRANS) associated with the selected STAR are available from the list of available TRANS in the right column. A TRANS is selected in a manner similar to the STAR. After the STAR has been selected, the list of available TRANS is displayed, as shown below on the right. If no transitions are appropriate for the route of flight, the TRANS prompt can be ignored. If a TRANS has been previously selected, and a TRANS is not desired, the NO TRANS prompt should be selected.



The fields at 1R and 2R display the selected SID and TRANS which will be inserted into the flight plan when the insert prompt is selected. These fields must be reviewed before inserting the STAR and TRANS to ensure that the correct procedure is being inserted.

Lateral Flight Plan Entry (continued)

STAR Entry (continued

Note: When selecting a new runway after a previous runway and STAR selection, the previously selected STAR and TRANS are automatically reselected (if allowed for that runway). If this routing is not desired, the NO STAR or NO TRANS prompt(s) should be selected as appropriate.

Once the STAR has been selected, the label line between STAR waypoints shows the name of the listed STAR.

If the STAR terminates with a “after XXX, maintain heading 175 degrees”, in many cases the STAR will terminate with a MANUAL segment. An example segment is shown on the BSV STAR at KCLE.

Lateral Flight Plan Entry (continued)

Destination Runway Selection

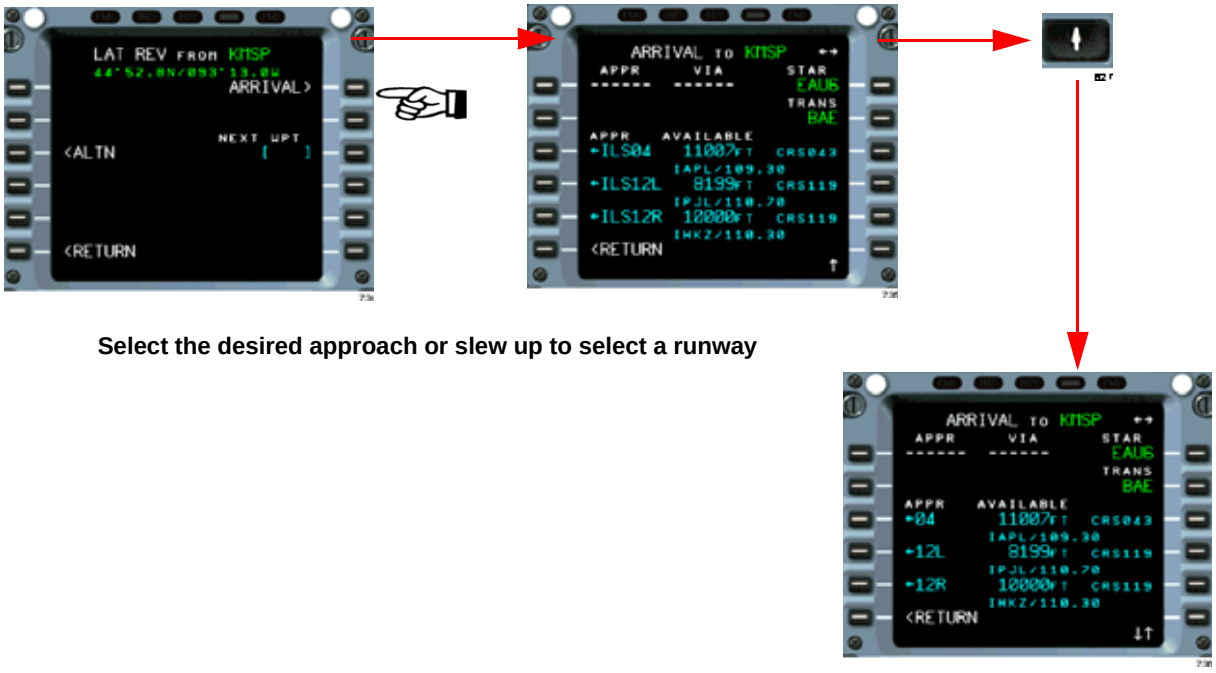
A destination runway can be entered into the flight plan before or after the STAR selection. Runways and approaches are selected from the same menu list. The runway may be inserted independently, or as part of a database selected instrument approach. The list of approach procedures is prioritized, starting with precision approaches, then non-precision approaches, and finally visual approaches (runways).

A visual approach typically contains one waypoint 5 miles out on the extended centerline, a runway threshold point, and a 3 degree vertical path to 50 feet above the runway threshold.

With a few exceptions, when an approach is selected a runway waypoint is included as part of the selected approach. Exceptions exist where the approach is not to a specific runway or the missed approach point is not at or near the runway threshold.

To enter a destination runway into the flight plan, the ARRIVAL page must be accessed as discussed previously in the “STAR entry” block.

The destination runway is selected when the approach procedure (precision, non-precision, or a visual procedure) is selected



Select the desired approach or slew up to select a runway

The slew arrows (if present) indicate that additional approach procedures and corresponding runways can be displayed by scrolling. A runway is selected by pressing the left LSK adjacent to the desired runway. A previously selected runway is displayed in green, without an arrow, and is displayed at 1L. Other available database runways are displayed in blue with adjacent arrows.

If a STAR was previously selected, it may be modified or extended by the selection of a runway. The portions of the STAR that are unique to the runway are not inserted until the runway is selected.

Lateral Flight Plan Entry (continued)

Destination Runway Selection (continued)

Once the runway has been selected, a temporary flight plan is created. The fields display the selected APPR at 1L, VIA at 1C, STAR at 1R, and TRANS at 2R, that will be inserted into the flight plan when the insert prompt is selected. These fields must be reviewed before inserting the STAR and TRANS to ensure that the correct procedure is being inserted.

Caution: *Pilot-entered STAR altitude and speed constraints will be inadvertently deleted if they are associated with the current active or TO waypoint and the STAR is reinserted into the flight plan (e.g. during a runway change). Database constraints are not affected. No message is provided to indicate that constraints have been deleted. Pilots should use caution when making changes to the flight plan when navigating to a waypoint with an assigned altitude or airspeed constraint.*

Note: If the runway is changed and a previously selected STAR is not deleted (by selecting the NO STAR prompt), the entire STAR is reinserted into the flight plan. This is not a problem if the aircraft is on a portion of the STAR routing, as portions of the procedure prior to the aircraft's current position are automatically erased. However, this can be confusing if it occurs while the aircraft is being vectored off of the STAR (for example, on vectors to final). For example, the aircraft has completed the NICKL STAR into MSP and is on a radar vector to final. If the runway is changed (from RWY 12R to 12L, for example), the entire NICKL STAR (and selected TRANS) will be reinserted into the flight plan unless the NO STAR option is selected. The entries at 1L, 1C, and 1R should always be reviewed before insertion.

Note: If there is only one database routing (e.g., a VIA) between the STAR and the selected instrument approach procedure, the FMS may automatically enter this routing into the flight plan. If it is not desired, the NO VIA prompt (discussed later) should be selected.

Lateral Flight Plan Entry (continued)

Approach Procedures

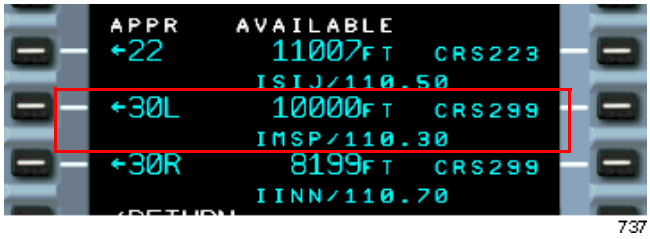
When choosing a runway, either an instrument procedure or a visual approach (e.g., VFR runway) can be selected. The list of approach procedures is prioritized, starting with precision approaches, then non-precision approaches and finally visual approaches.

Instrument Approaches

An instrument procedure includes at least one waypoint on the approach procedure, but may not include all the waypoints as published on the Jeppessen charts. The procedure includes the missed approach procedure (including holding). The missed approach procedure is displayed in blue (after insertion) on the F-PLN page and ND.

The FINAL and APP NAV flight guidance modes will only function with non-precision approaches selected from this list (refer to chapter 22, Autoflight).

ILS back course approaches are currently not in the database.



The runway information includes runway length, approach course and approach frequency and identifier.

Following a missed approach, the previously selected approach procedure is automatically re-entered into the flight plan.

A flight plan discontinuity is normally inserted into the flight plan immediately prior to the first waypoint of the approach procedure. However, the FMS may connect the approach and STAR procedure with a VIA if only one VIA is in the database.

Lateral Flight Plan Entry (continued)

Approach (continued)

Selection of one instrument approach procedure at a destination automatically erases previous approach procedures.

Selecting an approach autotunes the appropriate navaids (refer to chapter 34, Navigation: Navaid Autotuning).

Approach procedure routings from the Initial Approach Fix (IAF) are listed under VIAs (discussed later). These routings include DME arcs, procedure turns, holding in lieu of a procedure turn, and FMS arrival procedures.

The approach procedure includes the published mandatory altitude restrictions for the approach and missed approach. The missed approach altitude is listed as a minimum altitude (e.g., +2000). These restrictions can be displayed on the ND by using the EFIS CSTR pb.

The approach procedure may include routing from the Initial Approach Fix (IAF) to the Final Approach Fix (FAF). These routings are normally listed under VIAS. If only one VIA is available, it is automatically selected if the STAR routing, VIA, and approach procedure all connect. The IAF to FAF routing may include a procedure turn or a holding in lieu of a procedure turn routing (VIAs are discussed in detail later).

Lateral Flight Plan Entry (continued)

Approach (continued)

Non-Precision Approaches

Non-precision approaches are listed after the precision approaches. This list may not include all of the non-precision approaches at a particular airport. Localizer back course approaches are not in the database. The list of VIAs should be reviewed when selecting a non-precision approach. VIAs include IAF to FAF routings, arc routings, or waypoints that may significantly extend the final approach segment.

Navaids associated with the final approach course lateral guidance are automatically tuned if the TO waypoint belongs to the approach. Navaids used for step down restrictions are not automatically tuned.

An example NDB approach to runway 30L at MSP is shown below:

Note: Not all waypoints associated with step down fixes on the approach are necessarily listed on the approach procedure.

Missed Approach

The database missed approach, including holding, is automatically selected when the approach procedure is selected.

When a missed approach is initiated, the MCDU selected approach procedure is automatically re-entered into the flight plan in order to setup for a second approach with minimal pilot/MCDU interaction.

Lateral Flight Plan Entry (continued)

Approach (continued)

This missed approach is depicted as follows:

The holding pattern direction (HOLD R) and inbound course (358°) are automatically inserted as part of the missed approach procedure.

The missed approach procedure may include two types of vertical restrictions: conditional waypoints associated with the lateral flight plan, and altitude constraints in the vertical flight plan. The 1240' altitude in the example to the right is a conditional waypoint in the lateral flight plan which requires the aircraft to be above 1240 feet MSL before the FMS will command a left turn to FGT.

Lateral Flight Plan Entry (continued)

Approach (continued)

A conditional waypoint in the lateral flight plan which requires the aircraft to be at a specific altitude before turning may not automatically sequence if the FCU altitude and the conditional waypoint are at the same altitude. For example, the missed approach for the ILS01R at MKE requires the aircraft to climb to 2800' MSL and then turn to the holding fix.

If the FCU altitude is also 2800', the aircraft may level off a few feet below the altitude required to sequence this conditional waypoint due to system tolerances. The aircraft will continue on its current heading until the waypoint sequences. A turn can be commanded either manually (using HDG mode) or by performing a DIR TO the next fix.

If a leveloff is commanded at an altitude below the conditional altitude (for example, at 1000 feet AGL following an engine failure), the altitude conditional waypoint will continue to be “pushed” ahead of the aircraft until the aircraft climbs through that altitude.

Caution: *Altitude constraints in the vertical flight plan (e.g., cross XYZ at 3200' then climb to 5000’) are ignored in the FMS go-around phase.*

For the FMS to comply with altitude constraints (in the vertical flight plan) during a missed approach, the FMS approach (or climb) phase must be active. To comply with altitude constraints during a missed approach, the pilot can either:

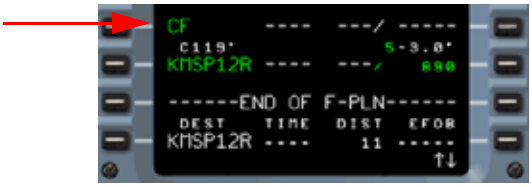
- Manually control altitude with the FCU altitude window
- Manually activate the FMS approach phase and ensure that the managed CLB mode is active
- Enter a new destination, causing the FMS CLB phase to engage
- Enable the flight plan alternate airport, causing the FMS CLB phase to engage

Lateral Flight Plan Entry (continued)

Approach (continued)

Visual Approach Procedure

A visual approach procedure includes the runway and a Course to Fix (CF) located at 5nm on the extended runway centerline. Selecting the visual runway also displays the descent path indicator on the PFD. The descent path indicator provides a 3 degree glide slope from the CF fix to a point 50 feet above the runway threshold.



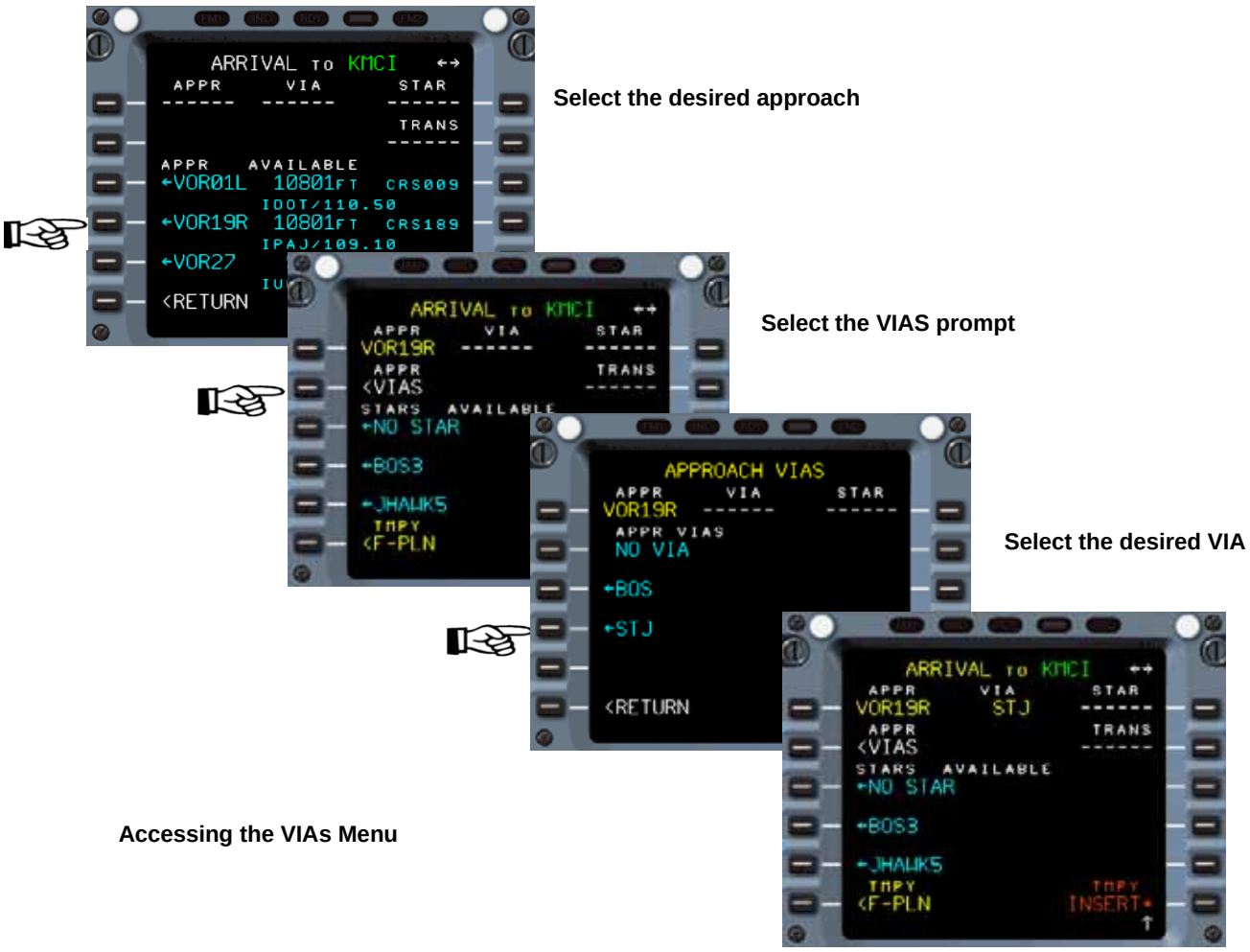
Lateral Flight Plan Entry (continued)

VIAs

Approach transition routes from the Initial Approach Fix (IAF) to the intermediate or final approach segments are listed as VIAS. When an instrument approach procedure has been selected, the VIAS prompt appears at 2L. VIAS can be used to:

- Connect a STAR to the approach procedure
- Provide a routing from an Initial Approach Fix (IAF)
- Extend the final approach segment
- Insert an FMS approach transition
- Insert DME arcs
- Insert a procedure turn from an IAF
- Insert holding in lieu of a procedure turn

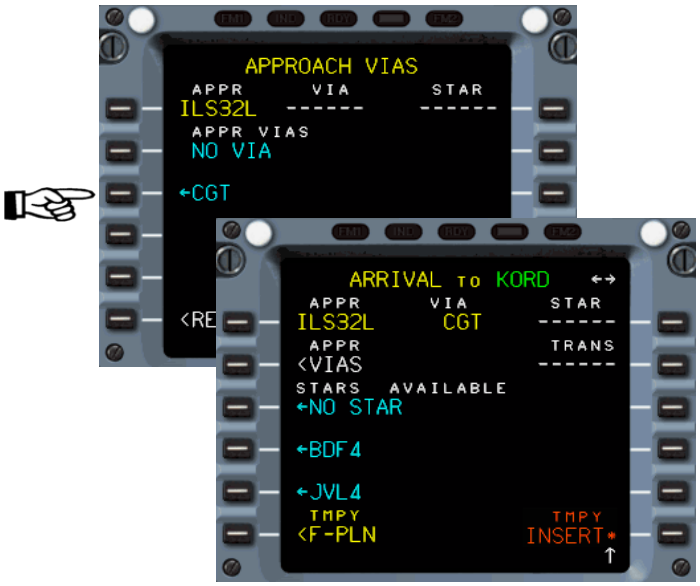
If only one VIA is in the database, and the STAR and approach are compatible, the VIA may be automatically entered into the flight plan when the STAR and approach are entered. If it is not desired, the NO VIA prompt must be selected.



Lateral Flight Plan Entry (continued)

VIAs (continued)

Some VIAs will extend the center line of the runway for ILS approaches at major airports that have a long final. For example, selecting the CGT approach VIA on the ILS 32L at ORD extends the flight plan as shown below.



Approach path start point without a VIA

Approach path start point with a VIA

If the VIA is not desired, this prompt can be ignored.

A VIA can be deleted by selecting the NO VIA choice at the end of the list of vias. The selected via is listed at 1C and should be reviewed before insertion.

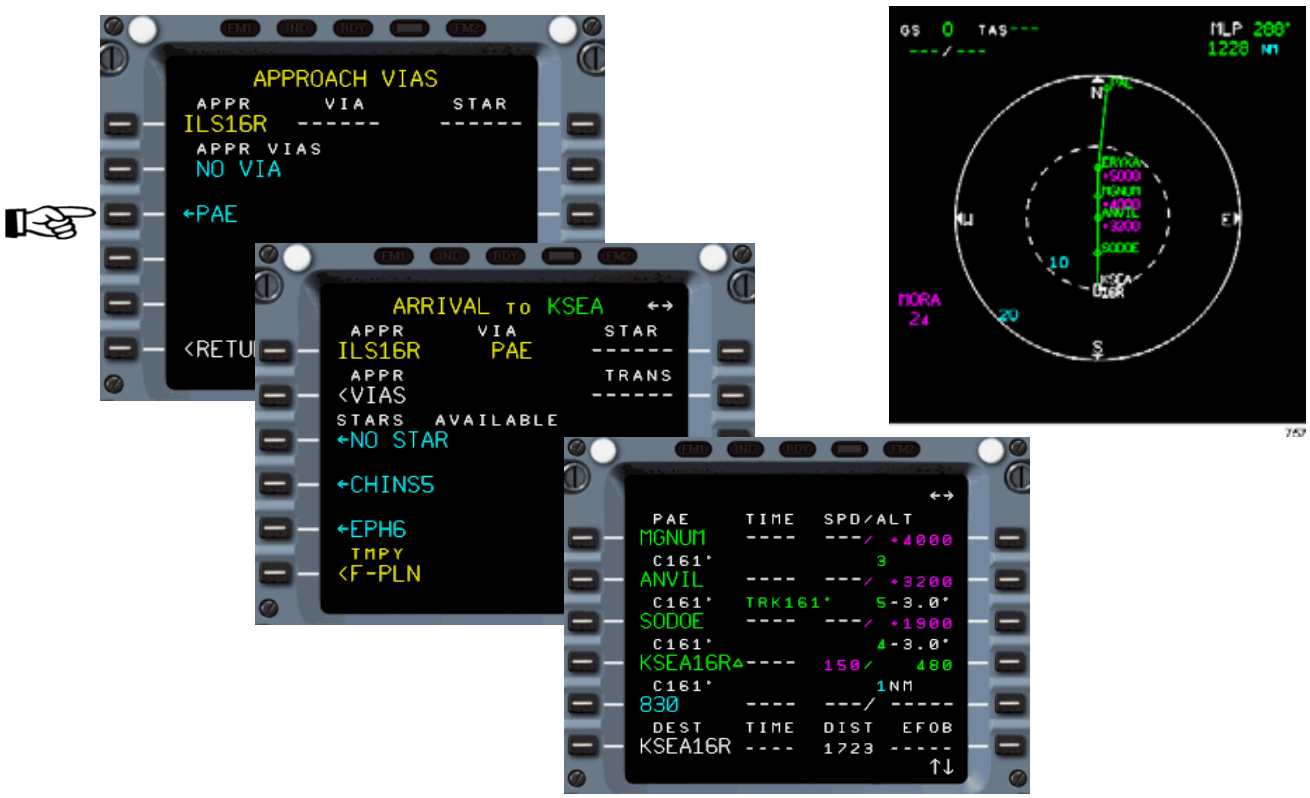
The VIAS prompt is displayed when the approach is first selected, and is available for review if a VIA has been entered for that approach.

Lateral Flight Plan Entry (continued)

VIAs (continued)

FMS Transitions

At some airports, FMS transitions are available. These transitions are accessed with the VIA prompt. The FMS transitions include the required altitude profile, allowing the entire lateral and vertical procedure to be flown managed. The JAKSN FMS transition at SEA is shown below.



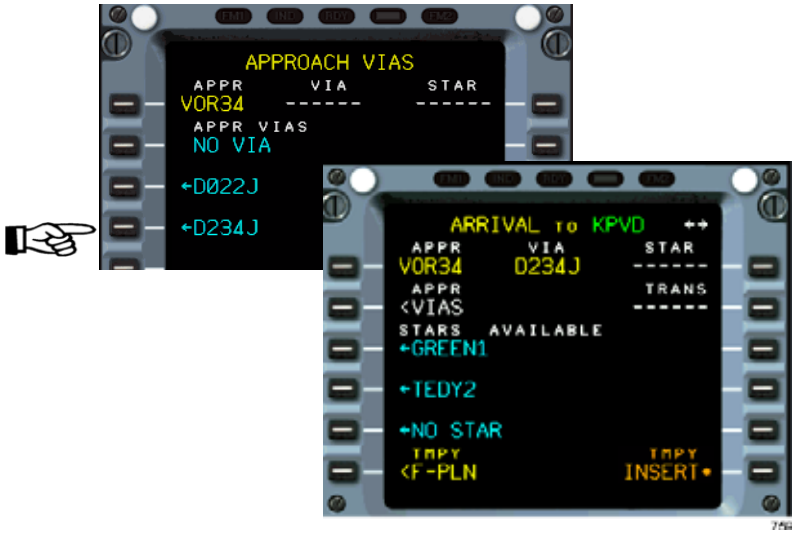
If only one VIA is in the database, and the STAR has an associated transition connected to the VIAS, then the FMS VIA will be automatically entered into the flight plan when the STAR and approach are entered. If it is not desired, the NO VIA prompt must be selected.

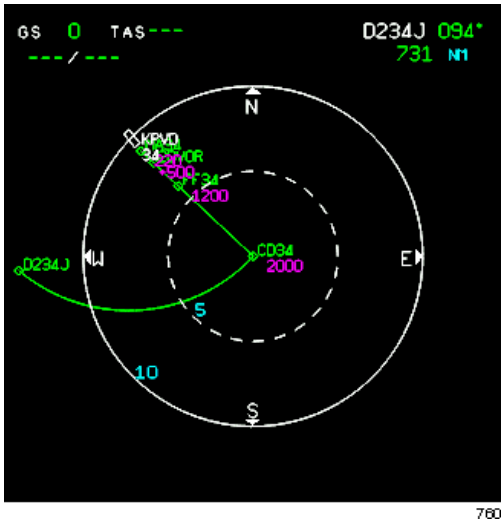
Lateral Flight Plan Entry (continued)

VIAs (continued)

DME arcs

DME ARCs provide routings from the IAF to FAF on some approaches. These routings are listed as VIAs. The DME arcs can be identified by noting the VOR identifier and radial which defines the start of the arc. For example, the VOR34 approach at KPVD uses the 10 DME arc to proceed from the IAF to the FAF. Either the PVD 022 (D022J) or PVD 234 (D234J) degree radials can be selected for the procedure, depending on whether an “arc right” or “arc left” clearance has been received. In the example below, the clearance “proceed direct to the PVD 234 degree radial 10 DME, arc right via the 10 nm arc, cleared for the VOR DME 34 approach” has been received. The PVD 234 (D234J) radial is selected in this case as the IAF approach VIA.





The DME arcs are coded with the VOR radials for the IAF or beginning of the arc. The last letter of the code indicates the distance of the DME arc, with A indicating 1 DME, B indicating 2 DME, etc. For example, the PVD 10 DME arc begins at the PVD 234 radial is coded as DJ34J (H=8 DME, I=9 DME, J=10 DME, etc.).

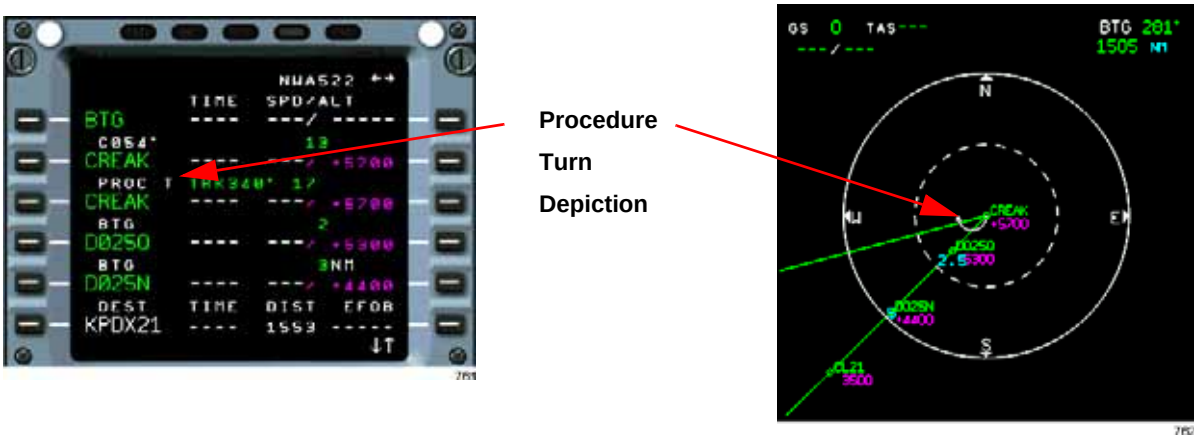
Some of the IAFs have waypoint names versus the coded points described above.

Procedure Turns

Description

A procedure turn is used during certain instrument approach procedures to align the aircraft with the final approach. Procedure turns are entered into the flight plan only from database procedures. The pilot cannot create a procedure turn. The procedure turn may be entered into the flight plan automatically if part of the instrument approach procedure. Procedure turns are usually selected as a VIA from an IAF.

The procedure turn is depicted on the ND and in the flight plan as follows:



It is important to notice that the procedure turn fix is displayed twice. If the pilot wishes to proceed to that fix and accomplish the procedure turn, a DIR TO, to the first line displaying the fix should be accomplished. If the pilot wishes to proceed to the fix and fly the approach without performing the procedure turn, either of the following may be accomplished:

- Perform a DIR TO to the second line displaying the fix
- Delete either of the lines displaying the fix and then accomplish a DIR TO to the remaining fix.

To delete the procedure turn from the flight plan, either one of the two procedure turn fixes can be deleted. This allows the final approach segment to remain in the flight plan.

Note: The FMS may not constrain the aircraft from violating maneuvering airspace during course reversal procedures. Pilots are responsible for procedural compliance.

Note: When flying this procedure during an ILS (or LOC only) approach, the LOC and G/S modes must not be armed until after the aircraft is inbound after the course reversal. If the LOC or G/S modes are armed prior to the course reversal, the aircraft will attempt to capture and track the localizer and/or glide slope when a valid signal is received. Refer to chapter 22, Autoflight, for a complete discussion of these flight guidance modes.

Holding in Lieu of a Procedure Turn

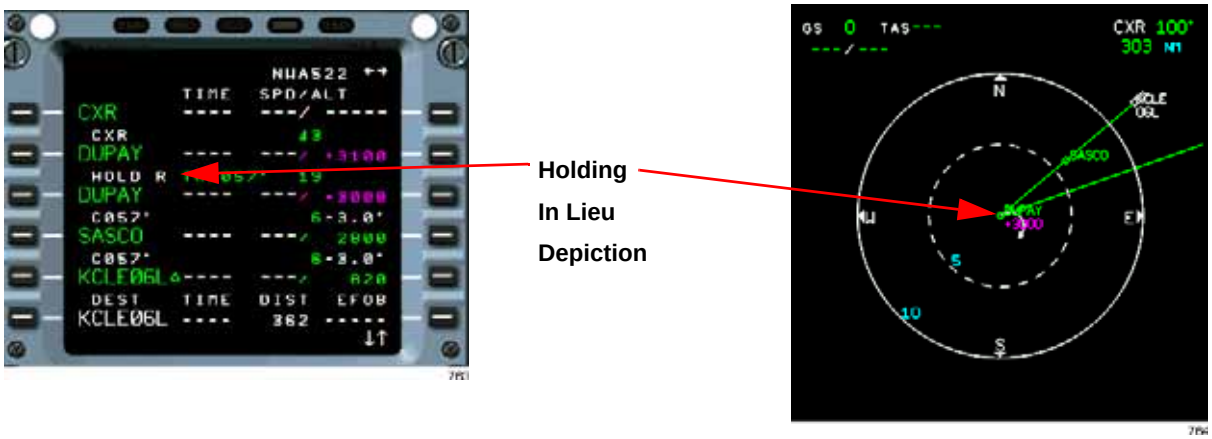
Description

A holding pattern is used during certain instrument approach procedures in lieu of a procedure turn to align the aircraft with the final approach. These holding patterns are entered into the flight plan only from database procedures, and are normally VIAs associated with instrument approach procedures.

This holding pattern cannot be used for normal holding. A new holding pattern must be entered at the designated waypoint (the first line that displays this waypoint) if continuous holding is desired.

A holding pattern in the flight plan used in lieu of a procedure turn has the following differences from a normal holding pattern:

- A lack of an amber IMM EXIT"or RESUME HOLD prompt at 2R, (discussed later in this section).
- A lack of a HOLD R (or L) waypoint between the holding waypoints. This holding pattern uses two lines instead of three on the flight plan. The label line between the entry of the holding waypoints depicts the direction of the turn.



When flying this holding pattern, the aircraft will cross the holding fix and then turn in the depicted direction. A second turn occurs to align the aircraft with the final approach segment. The holding pattern is automatically cleared when the aircraft crosses the holding fix the second time.

To delete this holding pattern course reversal from the flight plan the line that repeats the holding fix should be deleted. This allows the final approach segment to remain in the flight plan.

Note: The FMS may not constrain the aircraft from violating maneuvering airspace during course reversal procedures. Pilots are responsible for procedural compliance.

Note: When flying this procedure during an ILS (or LOC only) approach, the LOC and G/S modes must not be armed until after the aircraft is inbound after the course reversal. If the LOC or G/S modes are armed prior to the course reversal, the aircraft will attempt to capture and track the localizer and/or glide slope when a valid signal is received. Refer to chapter 22, Autoflight, for a complete discussion of these flight guidance modes.

Lateral Flight Plan Entry (continued)

Lateral Flight Plan Modifications

Modifications to the lateral flight plan are:

- Flight plan offsets
- Holding

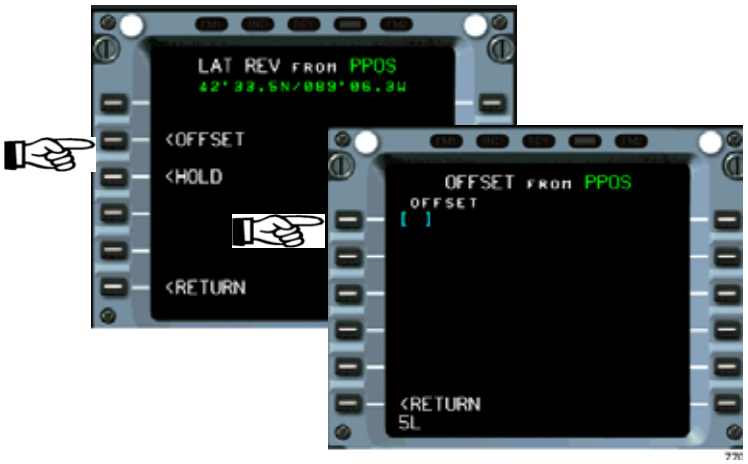
Changes to the lateral flight plan as a result of a new clearance are discussed in the section titled “Flight Plan Reroutes.”

Flight Plan Offsets

A flight plan offset allows the pilot to navigate off of the flight plan route on a parallel course. An offset course up to 50 nautical miles left or right can be entered. An offset course could be used, for example, to avoid weather along the airway.

An offset is entered by performing a LAT REV at the FROM waypoint (including a PPOS or TP waypoint). The offset distance (in nautical miles) and direction (L or R) is then entered at 2L.

An offset is not allowed when the TO waypoint is the destination or if the offset cannot be accomplished prior to sequencing the final waypoint of the flight plan.



A temporary flight plan is created that must be INSERTED or ERASED before further flight planning actions are allowed.

The temporary flight plan allows the pilot to experiment with offset distances before entry.

TMPY F-PLN

ACTIVE F-PLN

Lateral Flight Plan Entry (continued)

Flight Plan Offsets (continued)

An offset course is accepted by the FMS provided that the offset maneuver can be completed prior to the TO waypoint. If the NAV mode is engaged when the offset is inserted, an immediate 45 degree intercept course to the offset occurs. A smaller intercept angle to the offset can be accomplished by manually selecting a desired intercept heading. Once established on the intercept heading, the FCU heading knob is pushed, arming the lateral NAV mode to intercept the offset course.

When an offset course is active, the original flight plan is displayed as a dashed green line.

Note: Flight plan offsets are not copied into the secondary flight plan.

A waypoint overfly in the flight plan is ignored during an offset course. The overfly remains in the flight plan and will be accomplished if the offset is subsequently canceled.

The offset course parallels the flight plan routing for the remainder of the flight plan. If vectored off of the flight plan with an offset present, both flight plan lines on the ND will be dashed green. The FMS will only intercept the offset track. The original flight plan line cannot be intercepted until the offset is deleted.

The offset course is automatically canceled:

- Prior to the first leg not appropriate for an offset (for example, a procedure turn).
- When the active leg is modified (for example, a DIR TO).
- When the TO waypoint is the destination.

When the offset is automatically canceled, a DELETING OFFSET message is displayed.

An offset can be manually canceled by:

- Performing a DIR TO the desired waypoint
- Performing a LAT REV at 1L, pressing LSK 2L (OFFSET) and entering CLR at 2L

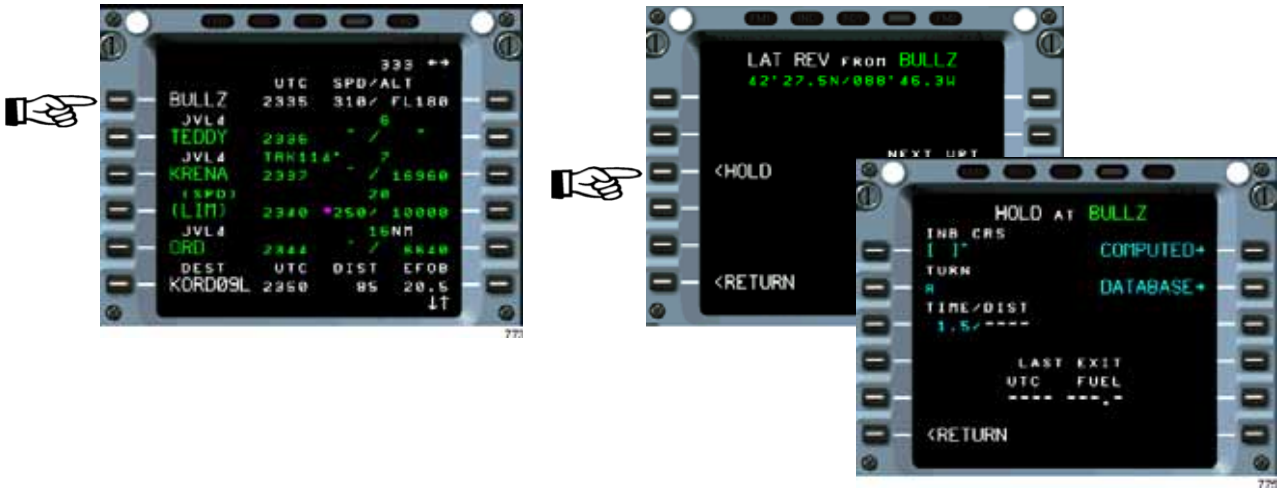
When an offset is canceled, a 45 degree intercept course back to the original flight plan is computed.

Lateral Flight Plan Entry - Holding

General

A holding pattern can be created at any flight plan waypoint except a pseudo waypoint, or the destination. A holding pattern is created by a LAT REV at the desired waypoint at which holding is to occur, then from the LAT REV page select the HOLD prompt.

A holding pattern at the aircraft's current position can be created by a LAT REV at the FROM waypoint (LSK 1L). This includes holding at PPOS and TP waypoints. This creates a hold at the current aircraft position when the hold is inserted.



Holding patterns are pre-defined for some waypoints in the database. If a holding pattern exists in the database for the referenced waypoint, that holding pattern's parameters are displayed by selecting the DATABASE hold prompt at LSK 2R.

The absence of an asterisk next to the DATABASE hold prompt means that a database hold does not exist for the selected waypoint. If a holding pattern exists in the database for the referenced waypoint, that holding pattern will be automatically selected and its parameters displayed in the appropriate fields.

If a holding pattern is not in the database for the reference waypoint, DATABASE will not be displayed.

Lateral Flight Plan Entry - Holding (continued)

Holding (continued)

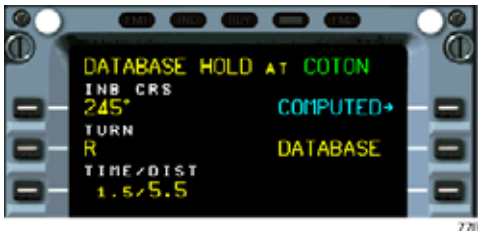
Both database and computed holding pattern definitions can be modified by overwriting the display value with the desired value. Legs can be defined by either time or distance.

The hold page title depicts the source of the holding pattern parameters.

Pilot created Hold

Computed Hold

Database Hold



A DATABASE hold is a pattern that is published on the Jeppessen charts. However, the database hold displayed may not correspond to the procedure to be flown. The charted holding pattern must be referenced to ensure that the proper hold is inserted.

A COMPUTED hold is a pattern that is FMS computed at fixes without published holding patterns, as follows:

- Right turns
- One minute legs at and below 14,000 MSL or 1.5 minute legs above 14,000 MSL
- An inbound course equal to the aircraft's computed track inbound to the holding fix

A HOLD (without a label) is one of the above patterns that has been modified by the pilot.

Lateral Flight Plan Entry - Holding (continued)

Holding Pattern Flight Plan Entry

The description of the holding pattern is displayed on the HOLD page, allowing the pilot to review or modify any desired parameters. The holding pattern is displayed on the ND as a temporary flight plan. The holding pattern must be inserted or erased before any other flight planning actions are allowed.

Database or computed values in the data fields are displayed in small font. Pilot entries are displayed in large font. All entries are displayed in yellow until the hold is entered into the flight plan, and then are displayed in blue. The flight plan page with the holding pattern is automatically displayed after holding pattern entry or erasure.

The holding pattern can be modified after the hold has been entered into the flight plan by making an entry into the desired field and then reinserting the temporary flight plan.

If the holding pattern is modified after the aircraft has entered holding, the change will take effect upon the next crossing of the holding fix.

INB CRS

The Inbound Course (INB CRS) is extracted from the database if available. If not, the course is entered with a manual entry or using the COMPUTED prompt.

The pilot can enter any desired course in this field. For example, if cleared to hold south of a fix, a 360 degree course is entered in this field. This results in a holding pattern south of the fix with a 360 degree inbound course. The holding pattern is depicted on the ND (in the plan mode) allowing the pilot to review the depicted pattern and make revisions as necessary.

TURN

The direction of turn is displayed. A standard right turn is always depicted unless the database hold requires a left turn. The pilot can change the direction of turn by entering L or R as desired.

Lateral Flight Plan Entry - Holding (continued)

TIME/DIST

The length of the holding pattern in minutes and the distance in nautical miles is displayed. These fields initially are based on the standard holding times as follows:

- 1.0 minutes at and below 14,000 feet MSL, or
- 1.5 minutes above 14,000 feet MSL.

If the hold is a TP or PPOS HOLD (e.g., holding at the FROM waypoint), the size of the holding pattern is computed at the aircraft's current altitude.

If the hold is at a waypoint, the size of the holding pattern is computed at the altitude the aircraft is predicted to reach at the hold. Either of these fields can be changed. If a desired time is entered, the distance is computed. A distance entry requires a preceding "/" (e.g., /10 for 10 nm legs), and results in the display of the computed leg time.

LAST EXIT/ UTC FUEL

The LAST EXIT UTC is the UTC time at which all fuel is burned except for:

- Estimated fuel burn from the holding fix along the flight plan to the destination
- Reserve (RTE RSV) fuel
- Final fuel (e.g., Delta alternate fuel)
- Alternate flight plan fuel as defined from the FLT PLAN DEST to the FLT PLAN ALTN (not used at Delta)

The fuel field displays the predicted fuel that will remain (in pounds) at the LAST EXIT UTC.

COMPUTED

The COMPUTED prompt selects the computed hold page.

DATABASE

The DATBASE prompt selects the database hold page.

Holding Pattern Operations

Once inserted into the active flight plan, the holding pattern is displayed on three lines. The first line is the holding fix. The second line depicts the direction of turn. The third line shows the inbound course and the holding fix again. An example holding pattern is shown below:

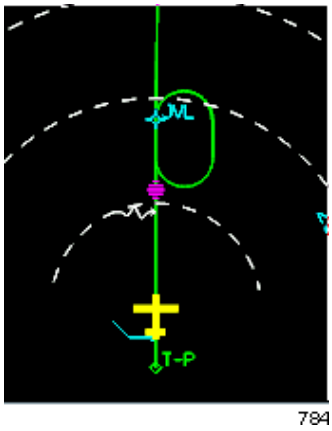
The computed holding speed (green dot) is displayed.

Lateral Flight Plan Entry - Holding (continued)

Holding Speeds

If airspeed is managed, the maneuvering speed for the current flap configuration (green dot, S, or F) is used as the holding speed. In managed speed, an automatic change to holding speed occurs at a computed deceleration point prior to the holding fix. This deceleration point is depicted by a magenta dot.

When the aircraft is less than 30 seconds from the holding pattern in selected speed, if the selected speed differs from the computed holding speed by more than 5 knots, SET HOLD SPEED is displayed in the scratchpad and on the PFD. Deceleration for holding has priority over the managed vertical path.



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Caution: *The computed holding speed may not comply with maximum holding speed limits, especially at high gross weights and low altitudes.*

If the holding pattern was defined by time and not leg distance, the size of the holding pattern and its depiction on the ND are based on the managed hold speed or selected target speed at the time the holding fix is crossed. If speed changes the pattern size is updated as the aircraft crosses the holding fix each time.

When the hold is exited, managed speed will change from the holding speed to the enroute econ speed.

Note: Holding patterns on a SID, STAR or approach procedure are erased if the procedure is re-entered into the flight plan.

Holding Pattern Entry

If the holding pattern (displayed as HOLD L or HOLD R) is the TO waypoint in the flight plan, the aircraft will enter the hold as the aircraft crosses the holding fix and no additional MCDU actions are necessary. The aircraft enters the hold using a normal procedure (direct entry, teardrop, or parallel) as necessary.

If the entry leg is on the limit between teardrop and parallel entry, the FMGC may compute and display either entry. If the inbound course is based on the reciprocal of the inbound course, a parallel entry will be used.

If the aircraft is on a heading, the holding pattern can be intercepted by making the holding fix the TO waypoint of the flight plan. The holding pattern is intercepted by arming the NAV mode and selecting an aircraft track which crosses any portion of the holding pattern.

Note: Holding patterns in the flight plan are ignored if the LOC mode is engaged. When exiting the hold, the pilot should use IMM EXIT or clear out the holding fixes to allow the FMS to keep up with the flight.

Lateral Flight Plan Entry - Holding (continued)

TURN AREA EXCEEDANCE

On instrument approaches containing procedure turns that require the aircraft to remain within a containment zone (distance), MCDU scratchpad and FMA messages are displayed if the projected procedure turn path exceeds this distance.

When constructing a procedure turn, the FMS will attempt to construct a lateral path that remains within the excursion distance defined in the NAV database. This distance is usually indicated on the approach chart.

The FMS uses current SEL speed, or next flap configuration speed (green dot, S, F) if in MAN speed to construct the procedure turn.

Based on this speed, if the FMS cannot create a procedure turn that remains within the excursion distance, a TURN AREA EXCEEDANCE message will be displayed in the MCDU scratchpad (amber) and on the FMA (white).

This message will be displayed once the aircraft gets within 1.5 minutes of a procedure turn leg or immediately if currently on a procedure turn leg. If this message is received, the pilot should

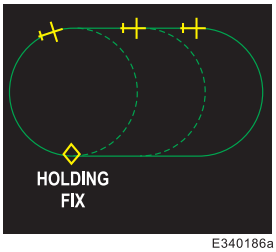
reduce airspeed. The FMS will recompute the procedure turn path and will delete the TURN AREA EXCEEDANCE message when the condition no longer exists.

Holding Pattern Exit

Prior to entering holding, and while holding, an IMM EXIT (immediate exit) prompt is displayed on the flight plan page.

Selecting IMM EXIT, when displayed, prior to entering holding, causes the aircraft to continue on the flight plan without entering holding and removes the holding pattern from the flight plan. The IMM EXIT prompt will not be displayed until passing the deceleration point.

Selecting the IMM EXIT prompt while in holding, the aircraft returns immediately to the holding fix and then proceeds along the active flight plan.



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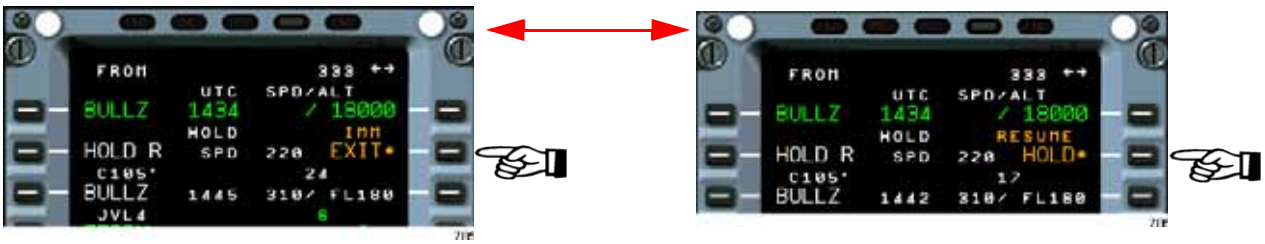
Effect of IMM EXIT

After the IMM EXIT prompt is selected a RESUME HOLD prompt is displayed at the LSK opposite to the HOLD R line until the aircraft passes over the holding fix. Selecting the RESUME HOLD prompt prior to the holding fix reactivates the holding pattern and the hold will continue. When selected, the RESUME HOLD prompt is replaced with IMM EXIT.



The holding pattern can be exited manually by selecting a heading, or executing a DIR TO. If exited by either of these methods the holding pattern must be cleared from the flight plan manually.

Note: If holding in managed speed, an exit will result in an acceleration to the appropriate managed speed for that FMS phase. For example, a hold is entered at 16,000 at green dot (for example, 210 knots). When the hold is exited, the aircraft accelerates to the managed descent speed (for example, 290 knots).

Lateral Flight Plan Entry - Holding (continued)

Deleting the Holding Pattern

If a holding pattern is in the flight plan, and is not required, it is deleted by clearing the line which contains the title of the holding fix the second time. The holding pattern can also be cleared by clearing the HOLD L or R line between the two fixes. Deleting the hold using either of these two lines allows the waypoint to be retained in the flight plan.

Accidentally clearing the first holding fix line clears the holding pattern from the flight plan. This action also eliminates that waypoint from the flight plan.

Prior to entry, the holding pattern may be deleted by clearing either waypoint.

Descending In Holding

If descending in a holding pattern in the managed DES mode, a fixed rate of 1,000 ft./min. is commanded. The DES mode will honor constraints in the flight plan after the holding pattern. If a higher descent rate is desired, a selected vertical mode should be used.

Lateral Flight Plan Modifications

General

The lateral flight plan can be modified at any time after the departure and destination airports have been entered. There is usually more than one method available for entering a new clearance into the flight plan.

The lateral flight plan can be modified using:

- Either of the F-PLN pages (A and B)
- The lateral revisions pages (LAT REVs)
- The DIR TO page

Modifications to the flight plan made on the flight plan page generate a temporary flight plan. The temporary flight plan can be further modified, inserted or erased.

The LAT REV page is displayed when any left LSK (except those adjacent to the destination lines, pseudo waypoints, and certain FMGC created waypoints) is selected with the scratchpad empty.

All changes made on the LAT REV page result in a temporary flight plan, which may be reviewed on the flight plan page and the ND prior to selecting TMPY INSERT.

The DIR TO page redefines the TO waypoint, and permits direct-to's or intercepts from the present position.

Lateral Flight Plan Entry - Holding (continued)

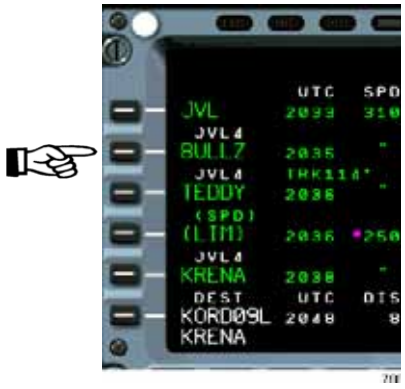
Flight Plan Page Modifications

Waypoints can be added to the flight plan as previously discussed under Waypoint Entry. Waypoints new to the flight plan result in a flight plan discontinuity after the waypoint. Adding a waypoint also takes you to the temporary flight plan for further modification or insertion of the temporary flight plan.

Any waypoint (except some pseudo waypoints) may be deleted on the flight plan page, presenting the temporary flight plan. A flight plan discontinuity may replace a deleted waypoint, unless it is a speed limit, HOLD waypoint, or time marker. The discontinuity may be cleared using the CLR key.

Several waypoints may be deleted by clearing them one at a time, or by entering a downline waypoint into the flight plan at an earlier point. If the entered waypoint exists at a later point into the flight plan, all waypoints between the new entry position and the later existence of the waypoint are deleted. This methodology allows quick deletion of numerous waypoints.

For example, assume a segment of the flight plan contained the waypoints illustrated to the right.



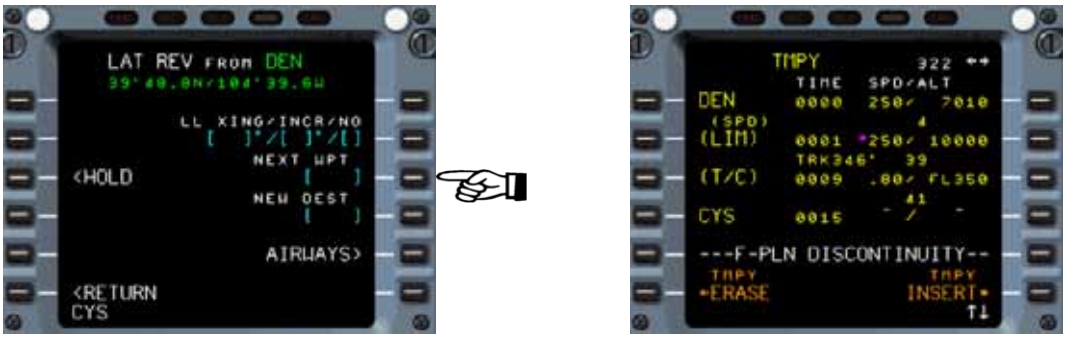
If a clearance to proceed to KRENA after JVL was received, BULLZ and TEDDY could each be cleared manually, followed by clearing the resulting flight plan discontinuity.

The same modification may also be accomplish by entering KRENA immediately below JVL. Then BULLZ and TEDDY would automatically be deleted. KRENA would follow JVL, and no discontinuity would be created because KRENA was not a new waypoint. Again, this would all be done in a temporary flight plan allowing for further modifications and allowing to see the temporary on the ND.

Lateral Flight Plan Modifications

LAT REV Page Modifications

Inserting a waypoint using the NEXT WPT field on the LAT REV page produces the same waypoint insertion, flight plan discontinuity, and waypoint deletion characteristics as entry on the flight plan page. The ERASE option allows the proposed change to be discarded. This option is always on the temporary flight plan page.



CYS inserted after DEN, Erase or Insert

Changing Destinations

The flight plan destination can be changed by:

- A LAT REV from any waypoint (including a Flight Plan Discontinuity) except from the current destination, any pseudo waypoints, or the FROM waypoint
- Entering the new destination as the flight plan alternate on the ALTERNATE page and selecting ENABLE ALTERNATE
- Entering a new FROM/TO on INIT A before engine start

To change the destination using the LAT REV page:

- Select a lateral revision from the last waypoint that should be retained in the flight plan (all subsequent waypoints will be automatically deleted)
- Enter the new destination airport identifier in the NEW DEST field.
- Review the temporary flight plan and select TMPY INSERT.
- In the example below, a diversion to KMKE is inserted at FOD. All waypoints after FOD and the destination are automatically deleted.

Lateral Flight Plan Modifications (continued)

Airway Intercepts

Any airway can be intercepted by defining the Airway in the FMS

The following illustrations will show a typical airway intercept.

The following clearance is received: “Fly heading 130 intercept J94 to ECK”. The aircraft is at the position shown below, with the flight plan as shown.

To enter this clearance into the flight plan, the pilot must define the airway by inserting (or verifying) the airway into the flight plan. This is done by inserting a from waypoint into the flight plan, laterally revising off of that waypoint, and inserting the airway into the flight plan and ensuring the insertion of that airway is reconnected to the original flight plan.

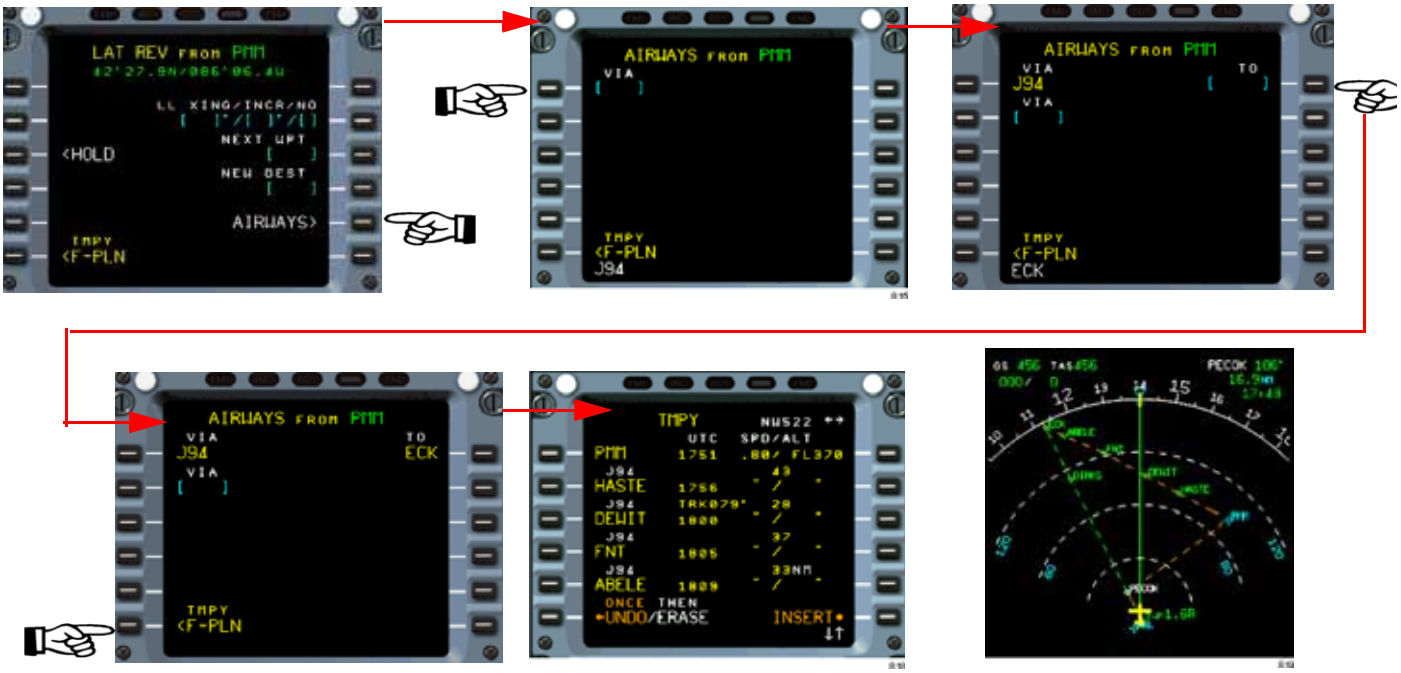
Lateral Flight Plan Modifications (continued)

Airway Intercepts (continued

Entering the clearance into the flight plan.

- Create a FROM waypoint. Any waypoint on the airway behind the aircraft's current position can be used. In this case, the pilot picks PMM as the FROM waypoint and enters it in the flight plan on the line below the current TO waypoint (line 3). This brings up the temporary flight plan.

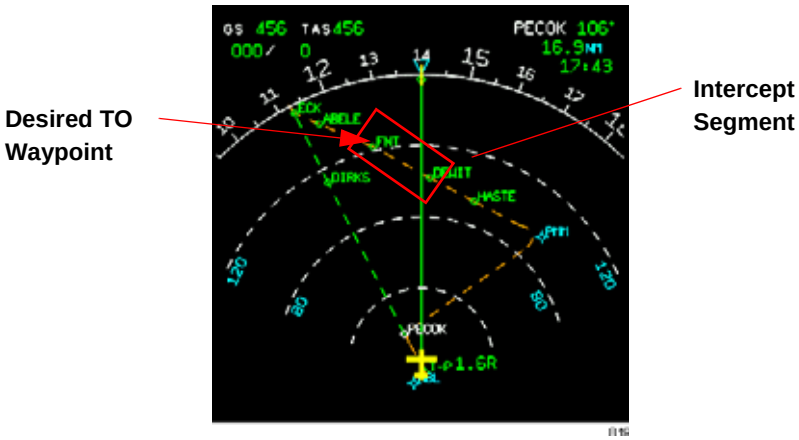
- Enter the airway (J94) from PMM, to the TO waypoint (e.g., ECK). The airway is entered by performing a LAT REV at PMM. This displays the lateral revision page on the temporary flight plan. Then select the AIRWAYS prompt at LSK 5R to insert the airway. Insert J94 into the VIA field at 1L and then the ending point (ECK) into the TO field at 1R. The resulting temporary flight is displayed on the temporary flight plan and on the ND in yellow, as shown below:



Lateral Flight Plan Modifications (continued)

Airway Intercepts (continued)

Using the ND, the pilot must now determine where on the airway the aircraft's track will intercept the airway. The FMS will only intercept the airway along the segment which is intersected by the aircraft's track. The desired TO waypoint will be the first waypoint on the airway that the aircraft will overfly once established on the airway.



The waypoint prior to the desired TO waypoint (e.g., DEWIT) must also be retained to allow the FMS to “draw a line” defining the airway. All other unnecessary waypoints must be cleared from the F-PLN. In this case, PMM was used to enter J94 into the flight plan. However, because the aircraft will intercept the airway between DEWIT and FNT, PECOK, PMM, and HASTE must be cleared to make FNT the TO waypoint.

In some cases, the FMS will automatically clear one or more waypoints from the flight plan as waypoints are cleared by the pilot. Clearing should normally be accomplished from the top line (the FROM waypoint), with a short pause to verify the status of flight plan waypoints before additional lines are cleared.

Once the waypoints are cleared, the flight plan and ND appear as shown below:

Once the temporary flight plan is verified to be correct, select the INSERT prompt at LSK 6R. This will insert the modification to the flight plan and display the active flight plan.

Lateral Flight Plan Modifications (continued)

Airway Intercepts (continued)

The NAV mode can be armed after these flight plan actions have been completed. Because the TO waypoint is FNT, the aircraft will turn to the left after intercepting this course and proceed along J94 to ECK. The final result looks like the flight plan and ND below.

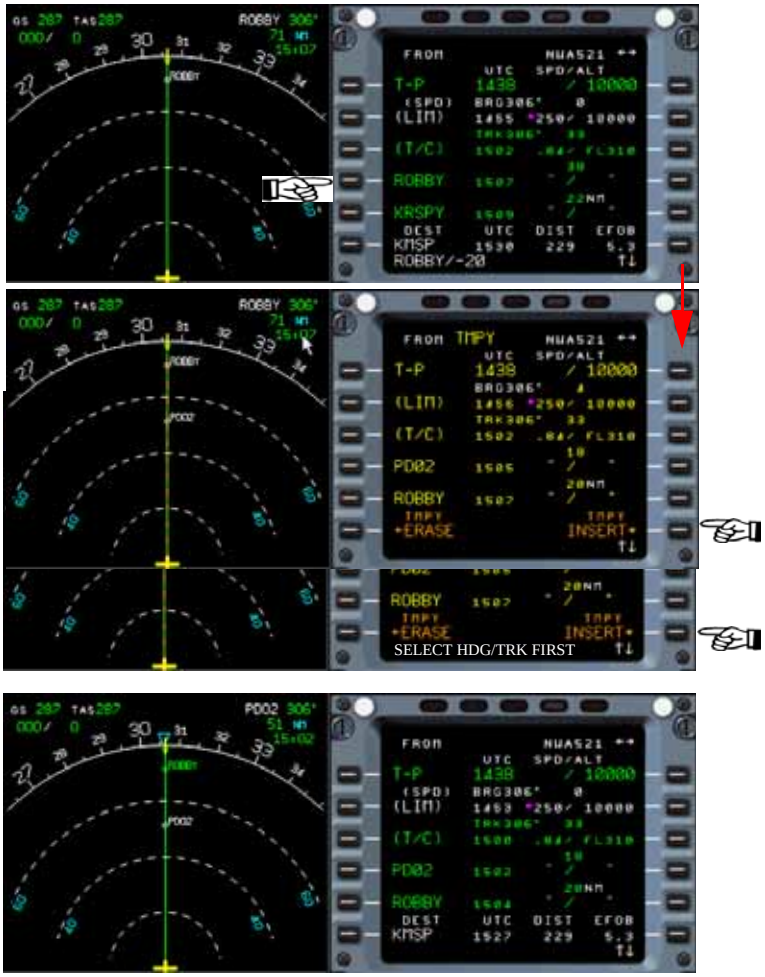
Lateral Flight Plan Modifications (continued)

Along Track Waypoints

Along track waypoints allows the entry of waypoints along the flight plan course line (without a discontinuity), before or after a waypoint.

To create an along track “Place/Distance” point, enter the identifier in the scratchpad followed by a slash, a “+”, or “-”, and the distance from the fix, with “-” being prior to the waypoint and “+” beyond the waypoint.

The example below shows a along track being inserted 20 miles before ROBBY.



In this example, PD02 is trying to inserted as the new TO waypoint. The FMS is requesting that you select HDG/TRK first to allow you to change the TO waypoint. Reengage NAV after inserting will put the FMS back into managed NAV.

If there is a waypoint between the initial point (ROBBY) and what would be the newly inserted waypoint (RWF/-20), the between waypoint must be used as the defining waypoint.

The defining waypoint cannot be an ABEAM waypoint.

Fix Info

General

The purpose of the FIX INFO is to provide supplementary navigational information for up to 4 reference points. For each reference point chosen as a REF FIX by the pilot the function:

- Displays any desired radial,
- Displays a radius of up to 256 nm
- Creates intersection points from the selected radials and radius in the F-PLN when they exist.

To access the FIX INFO page, the pilot must perform a lateral revision from:

- DEPT Airport
- PPOS
- Any active waypoint (excluding the DEST, missed approach and ALTN F-PLN)

It is not available on LAT REV pages from other waypoints.

Any waypoint, Navaid, Airport, or pilot created element can be used a a reference fix (REF FIX). The system searches for a specific radial perpendicular to the first applicable F-PLN leg. If an intersection is found a blue arrow is displayed adjacent to ABEAM at LSK [5L].

Line 5 displays the computed value of the ABEAM radial, ETA (UTC), distance along ACTIVE F-PLN to, and predicted altitude at the intersection point.

ABEAM radial is displayed on ND (blue dashed line). If the REF FIX is outside the map range, the radial may be shown, if it crosses the display area. However, radial is not displayed if across distance is great than 700 NM.

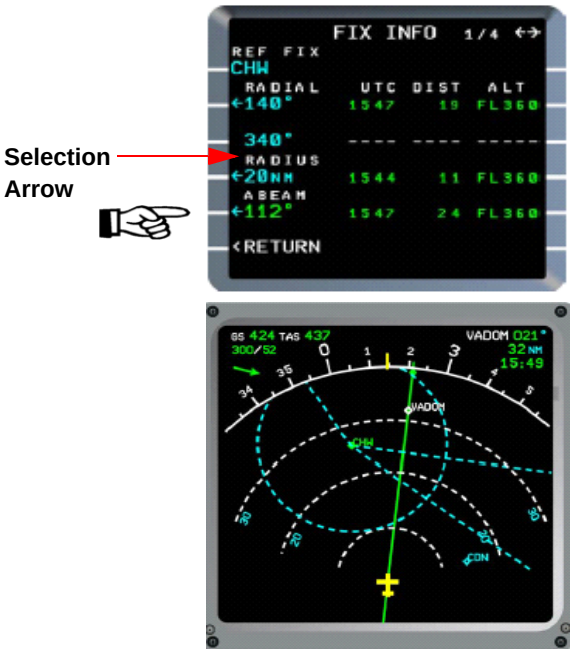
Fix Info (continued)

REF Radials/Radius

In addition, from the REF FIX up to two radials and one circle (radius up to 256 nm) may be simultaneously displayed by inserting the values in the respective fields at LSK 2L, 3L, or 4L.

If the intersection is within 0.5nm from a F-PLN WPT, no intersection point is created. However, the corresponding data are displayed.

If a selection arrow is displayed, the intersection point may be entered into the F-PLN.



Once the radials / radius are selected, a TMPY F-PLN is created and the respective point is displayed on the ND.

After the ABEAM point has been inserted into the ACTIVE F-PLN, the blue dashed line disappears, an abeam WPT is created and inserted into the F-PLN. Radial and Radius intersections can be inserted into the ACTIVE F-PLN using the procedures described above.

Abeam WPTs are named “ABxxxxx”, xxxxx representing the first five characters of the REF FIX. If a user define radial is inserted into the F-PLN, the point is named xxxyyy where xxx represents the 3 first characters of the REF FIX identifier and yyy shows the radial value. If a radius is inserted into the F-PLN, the point is named Dzzzxxx where zzz represents the radius (in miles) and xxx represents the first three characters of the REF FIX.

LL XING Waypoints

General

The LLXING function is accessed via a LAT REV on the F-PLN page. This function allows creation of specific LAT or LONG crossing point or a series of crossing points at specified intervals of latitude or longitude.

LL XING / INCR / NO

LLXINGs may be created at any LAT revised point between origin and last enroute WPT or before the WPT associated with the first descent constraint. This is also available in the SEC F-PLN.

In the example to the right, it is intended to create crossing points at parallels of longitude 103W to 98W.

The example shows 103W/1/5 (W103 is also allowed), to create 5 LL XING waypoints from longitude 103 degrees west, separated by 1 degree longitude increments.

From the lateral revised waypoint, a search is made downstream into the F-PLN for legs which cross the specified LAT or LONG. A TMPY is created with no discontinuity and no course change between the two legs.

If no legs cross the specified LAT or LONG, NO INTERSECTION FOUND scratchpad message (white) is displayed.

If the number of points to be computed is not indicated, the FMGC generates crossing points until the end of the enroute segment, within limits of F-PLN capacity.

The appropriate waypoints are displayed on the ND.

Time Marker

Time Marker Entry

Time Marker function enables pseudo waypoint(s) at specified time(s) to be entered in the ACTIVE F-PLN. These pseudo waypoints are shown on the ND and on the F-PLN pages.

To enter a time marker, press the F-PLN key and then enter directly into the F-PLN a valid time, (HHMM). Enter this on either F-PLN page A or B on any left select keys. Example below.

The time marker is inserted in the F-PLN. It is positioned;

- On F-PLN page position based on its UTC value with associated predictions.
- On ND by a green circle with UTC.

As other pseudo waypoints, a Time Marker is updated with predictions (i.e. based on changing flight conditions, F-PLN revisions).

When current clock time equals the Time Marker entry, the related time maker is sequenced.

Time Marker Rules of Entry

Up to four Time Markers may co-exist in the F-PLN at the same time. If four time markers exist in the F-PLN and another is entered, a TIME MARKER LIST FULL message is displayed in the scratchpad.

A Time Marker entry greater than current clock time plus 20 hours is rejected and a ENTRY OUT OF RANGE scratchpad message is displayed.

A Time Marker entry is rejected in either of the following cases:

- Clock is invalid
- FMGC is in preflight phase
- No ETT has been established

To clear a Time Marker, select the F-PLN page, scroll to find the marker and clear it like any other waypoint.

Vertical Flight Plan Entry

General

The vertical flight plan consists of:

- Wind entries
- Speed limits
- Speed constraints
- Altitude constraints
- Time constraints
- Step climbs and descents

The vertical flight plan can be entered only after the corresponding lateral flight plan has been entered. This is because the vertical flight plan is defined by associating the above items to specific waypoints in the lateral flight plan.

Vertical flight plan entry and modifications can be made on the flight plan page and vertical revision pages. The vertical revision pages are accessed by selecting the right LSK next to the associated waypoint.

Wind Entry

Winds are entered into the flight plan as follows:

- Climb winds are entered on the HISTORY WIND page via INIT page A (previously discussed - see Climb Wind Entry under Flight Plan Initialization).
- Enroute cruise winds are normally uplinked from the INIT A page WIND prompt then by selecting WIND UPLINK. The enroute winds can also be accessed and/or modified from the vertical revision page and selecting the ACCESS WIND prompt. Entering the wind directly on F-PLN page B is not allowed (previously discussed - see Enroute Wind Entry under Flight Plan Initialization).
- Descent winds are entered directly from INIT page A via the WIND prompt and then the NEXT PHASE prompt twice (previously discussed - see Descent Wind Entry under Flight Plan Initialization).
- The destination airport winds are entered on the DESCENT WIND page by using a GRND (ground level) wind on that page as previously discussed. In addition, cruise winds enroute to a flight plan alternate airport can be entered on the FUEL PRED page.

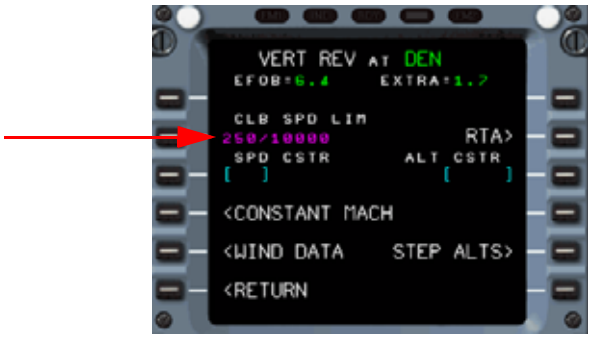
Vertical Flight Plan Entry (continued)

Speed Limits

The default climb (descent) speed limit is displayed in magenta on the VERT REV page. The speed limit is automatically entered in the flight plan twice: once during the climb phase and once during the descent phase. The speed limit is either:

- The default speed limit (250 KIAS/10,000 feet)
- A database speed limit associated with a specific airfield.

The speed limit altitude will be a flight level if the transition altitude is below the associated altitude.



The speed limit is always associated with an altitude. The flight plan climb and descent SPD LIM pseudo waypoints move in the flight plan to correspond to the points at which the aircraft is predicted to pass the speed limit altitude.

The speed limit can be deleted by either:

- Entering CLR at 2L
- Deleting the flight plan pseudo waypoint on the F-PLN page.

The aircraft will not exceed the speed limit in managed speed at the speed limit altitude. If the pilot wishes to accelerate to climb speed while level at 10,000 feet, the speed limit can be deleted. Deleting the speed limit while in a climb and at an altitude below 10,000 feet will allow the aircraft to immediately accelerate.

If the pilot wishes to remain at the managed descent speed after descending to 10,000 feet MSL, the speed limit can be deleted. However, this will allow the aircraft to exceed the speed limit in managed speed at altitudes below 10,000 feet MSL while in the FMS descent phase.

Vertical Flight Plan Entry (continued)

Speed Limits (continued)

If the speed limit has been deleted, managed speeds will be appropriate to the performance phase. For example, if the climb speed limit is deleted prior to takeoff, the aircraft will accelerate to the ECON speed (approximately 290 KIAS) at the acceleration altitude after takeoff. If the descent speed limit has been deleted, the managed speed (econ or auto) will exceed 250 KIAS below 10,000 feet.

If the speed limit has been deleted, brackets are displayed at 2L. If desired, a new speed limit and associated altitude can be entered into this field.

The speed limit and/or the associated altitude can be modified in this field. Speed limits are entered in KIAS only. Pilot entries are displayed in large blue font.

Speed Constraints

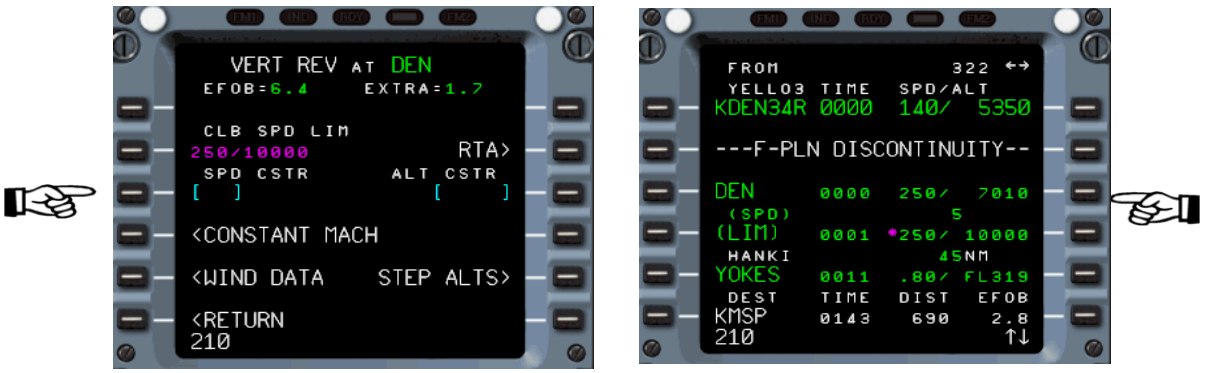
Speed constraints are entered into the flight plan at lateral flight plan waypoints. They can be entered manually, or automatically when part of a published procedure. The only speed constraints that are entered automatically are those that are published as “cross at”, (e.g., “Cross DEF at 250 KIAS”). Speed constraints that are “expected” (e.g., “expect to cross DEF at 220 KIAS”) are not automatically entered.

Manual Speed Constraint Entry

A speed constraint can be entered using either of the following methods:

- On the VERT REV page using the SPD CSTR field
- Directly into the flight plan on F-PLN page A by using the corresponding right LSK.

Both methods of entry for the clearance “cross KRENA at 210 KIAS” is entered as shown below:

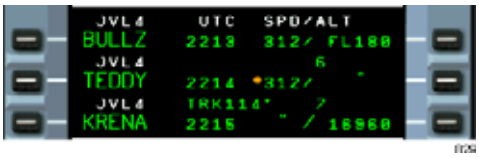


Vertical Flight Plan Entry (continued)

Speed Constraints (continued)

The speed constraint is initially displayed in magenta after entry on F-PLN page A. After calculations are completed, the FMS displays the computed speed at that waypoint in small green font. A magenta asterisk indicates that a constraint exists and it is predicted to be satisfied.

An amber asterisk is displayed if the constraint is predicted to be missed (the predicted speed is also displayed).



During the climb phase, the FMS limits the speed to comply with the constraint until that waypoint is sequenced. During the descent phase, the FMS limits the speed after the waypoint is sequenced. If the FMS cannot determine whether the speed constraint will occur during the climb or descent phase, CLB or DES prompts are displayed after the constraint is entered. The pilot must select one of these prompts before further flight plan actions can be accomplished.

Selecting a different MCDU page with these prompts displayed erases the speed constraint entry.

Note: If a lower flight plan speed occurs at the speed constraint, the flight guidance will command the lower speed. For example, the managed speed during the climb phase is 280 KIAS. The pilot enters a speed constraint of 300 KIAS. The aircraft will not exceed 280 KIAS (assuming managed speed is active).

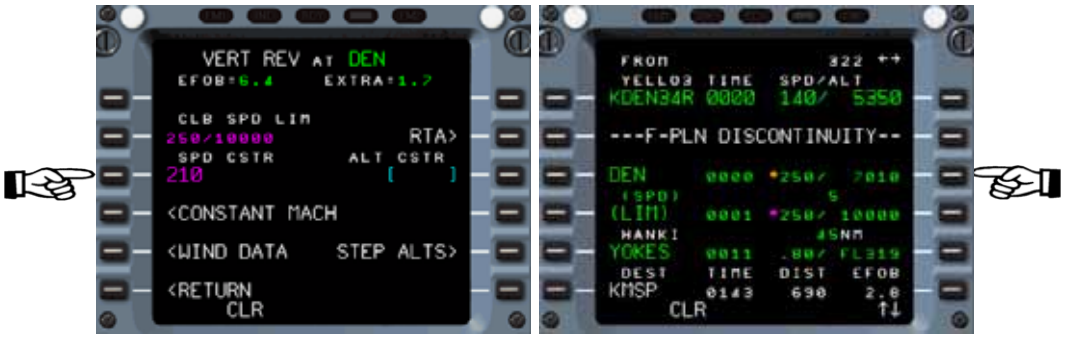
Vertical Flight Plan Entry (continued)

Speed Constraints (continued)

Speed Constraint Manual Deletion

A speed constraint can be manually deleted by:

- Deleting the associated lateral waypoint (e.g., entering CLR at the corresponding left LSK).
- Deleting both vertical constraints (SPD and ALT) at the waypoint (e.g., entering CLR at the corresponding right LSK).
- Performing a VERT REV at the waypoint and clearing only the speed constraint (e.g., entering CLR at 3L). This option allows an existing altitude constraint to remain in the flight plan.



Speed Constraint Automatic Deletion

Speed constraints that were entered by the pilot on a database procedure (SID, STAR, instrument approach, etc.), are automatically deleted whenever the procedure is reinserted into the flight plan, e.g., insertion of a database approach procedure).

Vertical Flight Plan Entry (continued)

Altitude Constraints

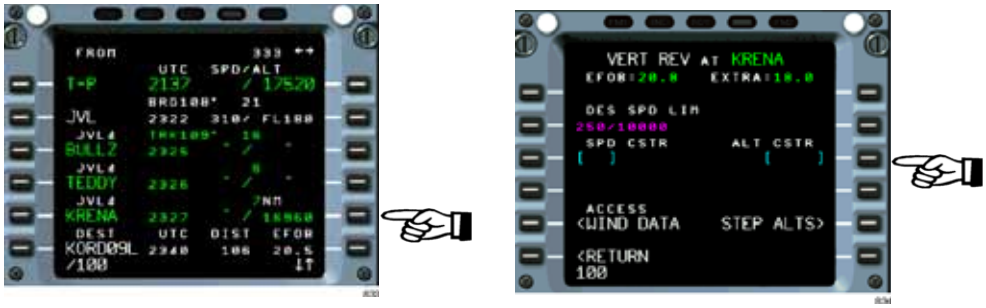
Altitude constraints are entered into the flight plan at lateral flight plan waypoints. They can be entered manually, or automatically when part of a published procedure.

Note: Altitude constraints that are “expected” (e.g., “expect to cross DEF at 11,000 feet”) are not automatically entered.

Altitude constraint are entered into the flight plan in a manner similar to speed constraints. An altitude constraints can be entered using either of the following methods:

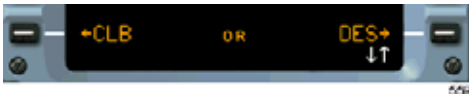
- Directly into the flight plan on F-PLN page A by using the corresponding right LSK and preceding the altitude value with a slash (/), (e.g., /100).
- Via a VERT REV at the corresponding waypoint.

Both methods of entry for the clearance “cross KRENA at 10,000’” are shown below.



The altitude constraint is initially displayed on the temporary flight plan. To make it effective, select TMPY INSERT. This will bring you back to the active flight plan.

During the climb and descent phases, the FMS computes the flight path to comply with the altitude constraint until that waypoint is sequenced. If the FMS cannot determine whether the altitude constraint will occur during the climb or descent phase, CLB or DES prompts are displayed after the constraint is entered. The pilot must select one of these two prompts before further flight plan actions can be accomplished.



Selecting a different MCDU page with these prompts displayed erases the altitude constraint entry.

An altitude and speed constraint can be entered simultaneously on F-PLN page A (e.g., 250/120 is 250 KIAS at 12,000).

An altitude constraint can be entered as either:

- At a specified altitude (/250)
- At or above a specified altitude (/+250)
- At or below a specified altitude (/-250)

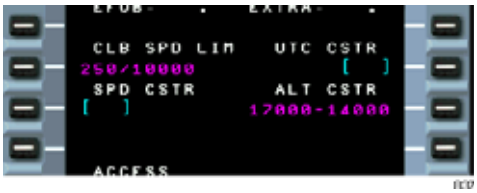
Vertical Flight Plan Entry (continued)

Altitude Constraints (continued)

A crossing restriction between two altitudes (e.g., cross XYZ between 7,000 and 14,000) can only be entered by entering a database procedure. These restrictions are displayed as a “window”. A window (cross CIVET above 14,000 feet and below 17,000 feet) is shown on a STAR at KLAX. The EFIS CSTR pb displays the constraints on the ND.

Window constraint on ND

Flight plan page



Vertical revision page

To verify the actual altitudes of the window on the MCDU, the pilot must perform a VERT REV at that waypoint or display the constraints on the ND.

The pilot can delete a window in a manner similar to the altitude constraints. Any pilot modification of the window altitudes replaces the window altitudes with the pilot entry.

Vertical Flight Plan Entry (continued)

Altitude Constraints (continued)

Altitude constraints can be entered using two, three, four, or five digits. A two or three digit entry is assumed to be a Flight Level (FL), while four and five digit entries are assumed to be MSL altitudes. The lowest altitude that can be entered is 1000 feet MSL, and the highest altitude is FL 390. Five digit entries which are above the transition altitude are automatically converted to flight levels, and flight level entries below the transition altitude are converted to MSL altitudes. Examples of correct altitude constraint entries are shown below:

- /FL240 (FL 240),
- /240 (FL 240),
- /24000 (FL 240),
- /FL120 (12,000 MSL),
- /120 (12,000 MSL),
- /12000 (12,000 MSL), and
- /1200 (1,200 MSL).

An altitude constraint cannot be entered at an altitude equal to or above the FMS cruise altitude (as displayed on the PROG page).

The actual value of the entered constraint is initially displayed in large magenta font on F-PLN page A during FMS calculations. After the calculations are completed, the predicted aircraft altitude at that waypoint is displayed. For example, the pilot enters a restriction to cross a waypoint above FL230 (/+230). The FMS initially displays +230 in large magenta font, and then displays 29,720 in small green font. This indicates that the aircraft's predicted altitude will be 29,720 feet MSL crossing that waypoint.

Vertical Flight Plan Entry (continued)

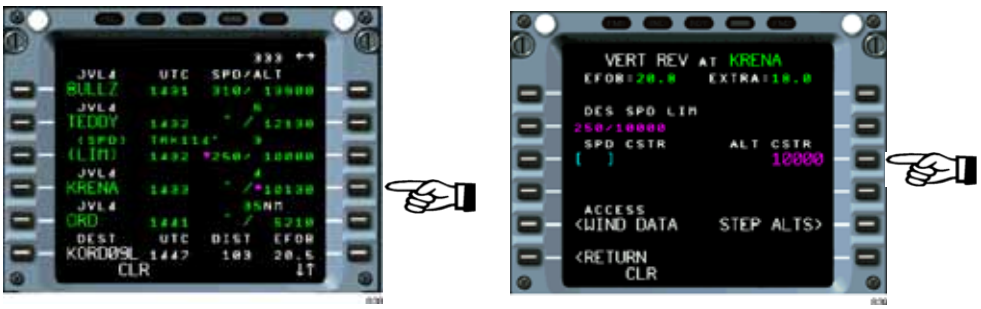
Altitude Constraints (continued)

The FMS considers an altitude constraint to be met if the aircraft's altitude is within 250 feet of the altitude constraint at the waypoint.

Altitude Constraint Manual Deletion

An altitude constraint can be manually deleted by:

- Deleting the associated lateral waypoint (e.g., entering CLR at the corresponding left LSK).
- Deleting both vertical constraints (SPD and ALT) at the waypoint (e.g., entering CLR at the corresponding right LSK).
- Performing a VERT REV at the waypoint and clearing only the altitude constraint (e.g., entering CLR at 3R). This option allows an existing speed constraint to remain in the flight plan.



Altitude Constraint Automatic Deletion

Altitude constraints that were entered by the pilot on a database procedure (SID, STAR, instrument approach, etc.), are automatically deleted whenever the procedure is reinserted into the flight plan.

Note: The pilot cannot modify altitude constraints that are part of database instrument procedures for obvious safety considerations. The FINAL vertical guidance mode does not function using manually entered altitude constraints for the same reasons.

Caution: *Altitude constraints in the vertical flight plan (e.g., "cross ABC above 4000 feet MSL") are ignored during the FMS go-around phase. Conditional waypoints associated with altitudes in the lateral flight plan (e.g., "at 2800 turn left direct SVM") are honored during the go-around phase.*

Vertical Flight Plan Entry (continued)

Vertical Discontinuity

The FMS will insert a “Vertical Discontinuity” into the flight plan whenever the computed vertical path cannot be met with the computed climb or descent capabilities of the aircraft. The computed descent capabilities include the use of 1/2 speedbrakes when necessary.

A TOO STEEP PATH AHEAD message is displayed in the scratchpad in cruise within 150 NM of the destination, or in the descent or approach phase, when the descent profile contains a segment that is too steep to fly with 1/2 speed brakes.

TOO STEEP PATH is displayed on the flight plan page between the two waypoints where the too steep path occurs.

E340215a

If the aircraft reaches this waypoint and the vertical discontinuity remains, the FMS cannot provide vertical guidance. Managed vertical flight guidance will disengage and the vertical speed mode will automatically engage, at the aircraft's current vertical speed.

The FMS recomputes the vertical deviation using an idle path to the end of the TOO STEEP PATH segment. Pilot intervention (e.g., speed brakes) may be required to comply with altitude restrictions.

A vertical discontinuity does not affect lateral navigation.

Step Predictions

General

A step prediction is a revision to the vertical flight plan. It allows the crew to evaluate a new cruise altitude at future waypoints without actually accomplishing the altitude change. The advantages of a step climb or descent are:

- Predictions (EFOB and ETA) based on the step can be evaluated prior to performing the step, and
- The FMS will remain in the cruise flight phase even when within 200 nm of the destination.

A step climb/descent is automatically deleted if it does not ensure at least one minute flight time at the new altitude.

The entry of a step climb/descent does not result in a change in aircraft altitude at the modified waypoint. An FCU altitude change is required before an altitude change occurs. When the FCU altitude change is initiated, the FMS cruise altitude is automatically updated to the new FCU altitude.

A step altitude may be entered:

- Manually during preflight planning
- Manually at waypoints from T/C to 50nm before T/D, called a geographical step,
- Manually selected or inserted on STEP ALTS page (optimal step)
- Uplinked via ACARS, (This is not operational at present).

The step climb/descent allows the pilot to evaluate predicted fuel and ETA due to varying altitudes and/or winds. These predictions include the use of fuel to climb or fuel savings during a step descent.

Pseudo waypoints are automatically inserted into the flight plan when a step climb or descent is inserted. These pseudo waypoints include the new top of climb, top of descent, and step climb or descent points.

When a step climb (or step descent) has been inserted in the ACTIVE F-PLN and when the aircraft is within 20nm of the S/C (or S/D) the STEP AHEAD scratchpad message is triggered.

If the step waypoint is sequenced without climb/descent initiation, the step is automatically deleted from the flight plan and a MCDU STEP DELETED message is displayed. This message is also displayed whenever the step waypoint is deleted. For example, this message is displayed when a clearance direct to the destination has been received which deletes the step waypoint.

A DIR TO to any waypoint beyond the step climb or descent waypoint automatically deletes the step.

Step Predictions (continued)

Access

A step climb/descent is initiated by accessing the VERT REV page at any waypoint (except pseudo waypoints). This will provide the STEP ALTS prompt on the VERT REV page. For example, a vertical revision at YOKES is shown:

Geographical STEP

To enter a geographical step altitude in the flight plan, access the STEP ALTS page as above. Once the STEP ALTS page is displayed enter an altitude and waypoint in the scratch pad and insert it in line 1 left. Example below.

Once TMPY F-PLN is selected, this will show the start of the step climb (T/C), fuel and time predictions. In case of step descent, S/D is displayed but position of level off is not shown. A climb arrow is also displayed on the ND.

Step Predictions (continued)

Specific Rules

A step altitude which results in an end-point less than 50nm before T/D is not accepted in F-PLN, IGNORED is displayed in line 1R. However, it is retained in the system in case of CRZ phase extension. This also applies if start point is found to be before T/C, or end point after T/D.

STEP ALT may be entered at a specified distance before or after a waypoint in F-PLN. (E.g. 370/HANKI/-20). In this case a PLACE/DIST waypoint is automatically inserted in the F-PLN.

Entry above the MAX ALT (based on predicted gross weight at the step start point) causes STEP ABOVE MAX FL scratchpad message. Additionally an ABOVE MAX message is displayed replacing the time and distance information on the STEP ALTS page.

When a step climb (or descent) has been inserted in the ACTIVE F-PLN and when the aircraft is within 20nm of the step;

- STEP AHEAD message is displayed in the scratchpad (white)
- For the active F-PLN, nothing is changed on the STEP ALTs page
- For the SEC F-PLN, STEP AHEAD annunciation is displayed on STEP ALTs page, replacing DIST and UTC information.

Step Predictions (continued)

Specific Rules (continued)

Up to four geographical step point may be entered starting at Line 1. Step points can be entered between brackets or by overwriting existing steps.

Geographical step entries are sorted and displayed in the same order as in F-PLN.

F-PLN Entry

A step altitude may also be entered directly into the F-PLN page A as a vertical revision right line select by entering S290 (290 meaning STEP ALT) at the revised point.

This creates a TMPY F-PLN, showing positions of S/C (or S/D) and predictions.

The step climb (or step descent) is not initiated automatically. **Flight level change must be initiated by the pilot with an FCU action**. If altitude change is not initiated, STEP DELETED scratchpad message is triggered (white).

Optimal Step

Optimal step predictions are only available for the climb phase. To enter optimal steps, there must not be any STEP ALTs selected on the STEP ALTs page. Enter only the altitude that is desired in line 1R, this will:

- TMPY STEP ALTS is displayed
- DIST and UTC at step point are shown
- Entered ALT must be above CRZ ALT, or ENTRY OUT OF RANGE scratchpad message is triggered (white).

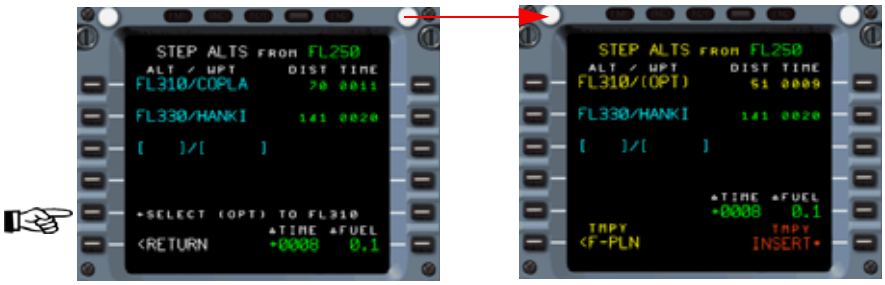
If the optimal step can be computed, time savings and fuel savings are displayed in line 6R. Fuel is shown in thousands of pounds and time is displayed in hours and minutes. The “+” or “-” signs indicate whether you have a positive or negative respective savings (e.g. “-” sign indicates a fuel or time savings).

Step Predictions (continued)

Optimal Step (continued)

If optimal step cannot be computed, a NO OPTIMAL message is displayed in line 1R.

A climb at a geographical step entered in line 1L may be optimized by using SELECT (OPT) prompt at 5L. Time and fuel savings are displayed in 6R.



If the FMGC cannot compute an optimal step point, the message NO OPTIMAL STEP appears in line 5L.

If an RTA exist, line 5 displays (OPT) FROZEN: RTA EXISTS, FMS is not able to compute optimal point.

If an optimal step is defined and the circumstances lead to a situation where this optimal step is no more optimal, NO OPTIMAL is displayed in 1R.

Step Predictions (continued)

Deleting a STEP

To delete a STEP altitude, clearing the step from either the STEP ALTs page or directly from the flight plan is allowed.

Step Speeds

The managed climb and descent speeds used for step predictions are calculated in a manner which blends climb or descent performance with the beginning and end cruise mach. In general, step climbs and descents are planned at the cruise mach number of the starting cruise altitude.

The managed cruise speed at the step altitude is computed in the same manner as at other FMS cruise levels.

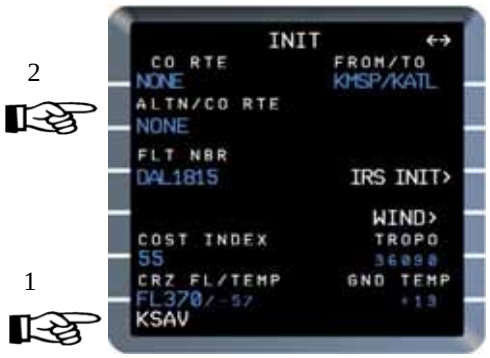
Alternate Airports

Alternate Airports

An alternate (ALTN) airport can be entered into the FMS, thus creating an alternate flight plan (ALTN F-PLN). This is normally accomplished automatically on preflight (during flight plan uplink). It may also be done manually during preflight (if there is no flight plan uplink) or while en route (if an alternate is added or changed). If two alternates are provided, the most distant alternate will be automatically uplinked into the ALTN/ CO RTE field [2L]. If manual entry of an alternate is required, the pilot must enter the more distant alternate in this field. An alternate (ALTN) airport can be entered in the MCDU F-PLN in a few different ways:

- Automatically during flight plan uplink in the ALTN/CO RTE field on INIT page A.

- Manual by entering an ALTN identifier in the ALTN/CO RTE field [LSK 2L] on INIT page A



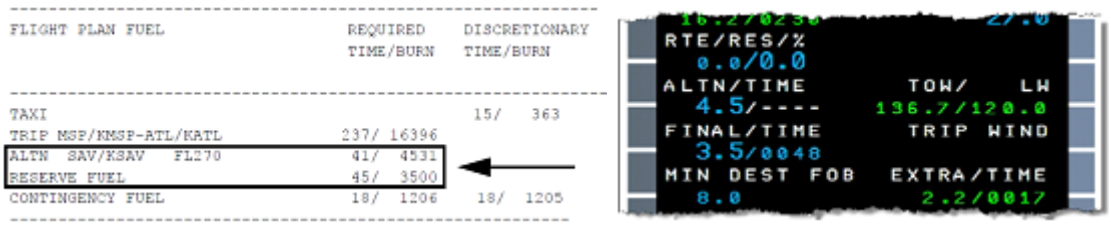
- The previous two methods are the preferred means of entering an alternate, however, alternate entry may also be accomplished by performing a LAT REV at the DEST [LSK 6L], selecting the ALTN prompt and then entering the ALTN identifier in the field provided.

Alternate Airports (continued)

Alternate Airports (continued)

Alternate Fuel

Although the FMS will calculate a fuel burn to the alternate, flight dispatch provides the pilots with a more conservative ALTN fuel burn value that must be used. The ALTN fuel burn value is found in the FLIGHT PLAN FUEL block of the flight dispatch release. If an alternate is added or changed en route, dispatch will provide the pilot with a fuel burn to the newly added alternate. In the case where two alternates are provided, fuel burn to the more distant alternate will be provided in this block. This value must be inserted in the ALTN/ TIME field [4L] on INIT B or the FUEL PRED page in order for the FMS to perform accurate fuel predictions.



Alternate Airports (continued)

Alternate Fuel (continued)

The EFOB at the flight plan destination and the flight plan ALTN are displayed on the FUEL PRED page. These values include the FMS reserve fuel.

ALTERNATES Page

The ALTERNATES page can be accessed by performing a LAT REV at DEST [LSK 6L], selecting the ALTN prompt and entering the ALTN identifier in the blank field at [LSK 3L].

ALTN: The alternate currently listed in the flight plan is displayed. If no ALTN has been specified in the active flight plan, NONE is displayed.

[LSK 3L]: Blue brackets are displayed for entry of an alternate; KCHS in the example above. Once the alternate is inserted into this line, a Left arrow will appear next to the alternate. Selecting the alternate [LSK 3L] will put the designated alternate into the temporary flight plan, which can then be inserted or erased.

NO ALTN: Selecting this prompt clears an alternate from the flight plan, and erases the alternate flight plan.

RETURN: This prompt selects the F-PLN page A.

CO RTE: Currently not used, this field displays the CO RTE identifier if used to insert the alternate. The field is blank whenever an alternate is entered into the flight plan.

Alternate Airports (continued)

ALTERNATES Page (continued)

TRK EXTRA DIST [2R]

The TRK field displays the aircraft's magnetic track from the destination airport direct to the alternate.

The EXTRA field shows how much extra fuel is remaining at the alternate (not including the FMS Reserve fuel).

The DIST field depicts the direct routing distance from the destination airport to the alternate.

Note: This field is populated initially upon ALTN entry, but is blank (---) once the pilot enters a dispatcher generated fuel burn to the alternate on INIT B or the FUEL PRED page.

EXTRA [4R]: Displays extra fuel (not including the FMS Reserve fuel) at destination if NO ALTN is selected.

Deleting an Alternate

An alternate can be deleted from the flight plan by:

- Entering NONE in the ALTN/CO RTE field [2L] on INIT page A
- Selecting the NO ALTN prompt [5L] on the ALTERNATES page
- Entering a new destination in the MCDU flight plan

Note: An alternate cannot be directly cleared from the flight plan pages.

Alternate Airports (continued)

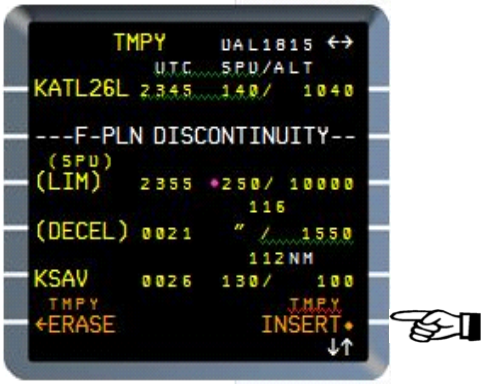
Alternate Flight Plan Displays

The alternate flight plan is displayed on the MCDU F-PLN page. It immediately follows the active flight plan, and can be accessed by pressing the ARPT p/b twice or by scrolling through the end of the F-PLN. Routing (including a STAR and instrument approach) can be specified from the destination to the alternate, however in order for the fuel predictions to be accurate, the dispatcher provided fuel burn must include this routing. Unless otherwise specified in the flight release, the fuel burn is typically calculated directly from destination to the alternate. The ALTN F-PLN is depicted in blue in the MCDU and a by dashed blue line on the ND.

Diversion to the filed Alternate (Enabling the Alternate)

If a diversion to the filed alternate is required:

- Perform a LAT REV from the last F-PLN waypoint to be used.
- Select the ENABLE ALTN prompt and INSERT the resultant temporary F-PLN.



The result will be a new F-PLN from the destination to the alternate located immediately after the waypoint where the LAT REV was performed.

After enabling the alternate:

- The cost index (CI) is set to 0.
- The FMS flight phase changes to CLB.

Alternate Airports (continued)

Diversion to the Alternate (Enabling the Alternate) (continued)

- A cruise altitude (based on the distance to the alternate) is entered on the PROG page:
  - 10,000' for alternates within 100 nm,
  - FL220 for alternates 100-200 nm, or
  - FL310 for alternates greater than 200 nm.

MCDU Messages

Color

The color of a MCDU message may be WHITE or AMBER. As a general rule, AMBER messages are those concerning navigation, requests for data entry, and those with corresponding ND messages. WHITE messages are less important messages, or as a result of a pilot MCDU action. In the Table below, the amber messages are listed in an amber color, white messages are normal font color.

Messages

MCDU messages are listed alphabetically in the following table.

If the same message is also displayed on the PFD or ND, “PFD msg” or “ND msg” is noted. If the PFD or ND message differs from the scratchpad message, it is included in brackets (e.g., PFD msg [xxx])

Message	Condition
A/C POSITION INVALID	The aircraft position is invalid.
ABEAM POINTS LIST FULL	Attempt to ABEAM more than 50 waypoints.
ALIGN IRS	The IRS coordinates for alignment must be entered on the INIT A page.
ALTN F-PLN DELETED	The alternate flight plan has been deleted.
AOC XXX F-PLN UPLINK	F-PLN UPLINK Completed without errors.
AREA RNP IS XX.XX	The RNP value entered on the PROG page is greater than the default value for the current flight area, and there is no value defined in the database for the active leg or route.
AWY/WPT MISMATCH	The WPT on the VIA/GO TO on the LAT REV page is not on the entered airway.
BLOCK IGNORES RTA	A time constraint (RTA) exits in F-PLN at initiation of fuel planning, or A time constraint (RTA) is entered while fuel planning function is active.
CABIN RATE EXCEEDED	When within 150 nm of the destination and the computed aircraft descent exceeds the aircraft ability to re-pressurize at the selected maximum rate.
CHECK ALTN WIND	The uplinked alternate cruise level is different from the FMS alternate cruise level.
CHECK APPR SELECTION	A non-ILS database approach has been entered in the flight plan, and an ILS frequency has been manually tuned. The FCU APPR pb will engage the APPR NAV mode and the LOC and GS modes are not available.
CHECK DATABASE CYCLE	The current date does not match the effective date of the active database, and a FROM/TO or CO RTE entry is made.

MCDU Messages (continued)

Messages (continued)

CHECK DEST DATA	A/C is in CRZ phase and distance to destination is less than 180nm. QNH, TEMP, WIND on PERF APPR page not filled in.
CHECK FLT NUMBER	Flight number is received valid but different from flight number previously sent in the downlink message.
CHECK WEIGHT	FMGC and FAC computed gross weights disagree significantly.
CHECK IRS (1/2/3) POSITION/ FM POSITION	FMGC position compared to the specified IRS position has exceeded a threshold (the threshold value increases over time).
CHECK QFE	At transition from QNH to QFE reference, the AD baro altitude and the AD standard altitude differ by more than 100 feet.
CHECK TAKEOFF DATA	A change was made to the departure runway, takeoff, shift, or FLEX TO temperature after V1, VR, V2 are inserted, or the secondary flight plan was activated during preflight.
CLOCK IS TAKEOFF TIME	An estimated Takeoff Time (ETT) constraint (UTC constraint at the origin) is entered and clock time is greater than or equal to the ETT constraint.
CLOCK/GPS TIME DIFF	A difference of greater than 3 minutes exists between the clock and GPS time. Message will clear when time difference decreases to 1 minute or less.
CONSTANT MACH DELETED	A constant mach segment exists and is deleted by changing the flight plan.
CROSSLOAD ABORTED	NAV database crossload is unsuccessful.
CROSSLOAD COMPLETE	Displayed upon successful completion of the NAV database crossload. Dual operation is then recovered through a resynch sent by the transmitting FMGC.
CRZ FL ABOVE MAX FL	The entered cruise altitude is above computed maximum altitude.
CSTR DEL ABOVE CRZ FL	A F-PLN altitude constraint has been deleted due to a cruise or step down altitude which was inserted at or below the F-PLN constraint.
CSTR DEL UP TO WPT01	Displayed when constraints get deleted due to a transition to go-around phase prior to sequencing the destination.
DECELERATE PFD msg [DECELERATE]	The aircraft is still in cruise or climb phase beyond Top of Descent and in speed auto control.

MCDU Messages (continued)

Messages (continued)

Message	Condition
DEST EFOB BELOW MIN	A/C is in Cruise or Descent for more than 2 minutes or in ALT mode for more than 10 minutes, and - The FOB (F-PLN or FUEL PRED pages) is below MIN DEST FOB for more than 2 minutes. - If conditions are still true, message is retriggered at transition to DESC phase.
DEFAULT STATE ASSUMED	All initialization data is cleared after a very long term power interrupt. Generally only seen when powering up a new MCDU.
DELETING OFFSET	An offset has been automatically deleted.
DEST/ALTN MISMATCH	An attempt is made to enter an alternate CO RTE that does not have the same origin as the primary destination.
DIR TO IN PROCESS	A LAT or VERT REV attempt was made on one MCDU with the DIR TO page displayed on the other MCDU.
ENTER DEST DATA	WIND, QNH, or TEMP not inserted in the PERF APPR page when the aircraft is within 180 NM of the destination.
ENTRY OUT OF RANGE	Attempted data entry is out of the range specified for the selected field.
F-PLN FULL	The memory required is more than is available in the buffer area. The F-PLN memory locations are insufficient.
FMS1/FMS2 A/C STS DIFF	The message precedes a transition to independent mode at power-up if a difference is detected in one of the following: NAV database Performance database FM operational program aircraft and airline program pins
FMS1/FMS2 GW DIFF	Onside and offside aircraft weight differs significantly.
FMS1/FMS2 PGM PIN DIFF	Onside and offside program pins are different. INDEPENDENT mode.

MCDU Messages (continued)

Messages (continued)

FMS1/FMS2 POS DIFF	Onside and offside positions differ by more than the following values: - More than 0.5 nm when GPS mode is active. (GPS equipped aircraft only). - More than 5 nm when GPS mode is not active. Message clears when difference between FMS positions is: - Less than or equal to 0.3 nm when GPS mode is active. (GPS equipped aircraft only). - Less than or equal to 3 nm when GPS mode is not active.
FMS1/FMS2 SPD TGT DIFF	Onside and offside target speeds differ significantly.
FORMAT ERROR	A data entry does not meet the specified entry format for a given field.
GPS IS DESELECTED	GPS has been manually deselected and the A/C is within 80 nms of Top of Descent (T/D) or the approach phase is activated. (GPS equipped aircraft only).
GPS PRIMARY	GPS is active and NAV ACCURACY is HIGH. (GPS equipped aircraft only).
GPS PRIMARY LOST	GPS is no longer active or: - Accuracy is LOW with GPS PRIMARY - Accuracy is HIGH and GPS is not active and the approach phase is activated. (GPS equipped aircraft only).
INDEPENDENT OPERATION	The FMGCs are operating independently.
INITIALIZE WEIGHTS	ZFW or block fuel (FOB) have not been defined at engine start.
INSRT/ERASE TMPY FIRST	Attempting to use DIR TO while a TMPY F-PLN exist.
IRS ONLY NAVIGATION	Radio position is invalid.
LAT DISCONT AHEAD	The aircraft is within 30 seconds of a lateral discontinuity.
LIST OF 10 IN USE	Attempt has been made to enter more than 10 stored runways into the database (no more allowed).
LIST OF 20 IN USE	An attempt has been made to create a PBD, LAT/LONG, or PBX, or store a pilot defined waypoint or navaid when 20 are already in the F-PLN (no more allowed).

MCDU Messages (continued)

Messages (continued)

MCDU OVERHEATED	Displayed for 15 seconds if the MCDU is overheating.
MORE DRAG ND msg	Speedbrakes are requested to capture a path.
NAV ACCURACY DOWNGRADE ND msg	NAV accuracy has been downgraded from HIGH to LOW.
NAV ACCURACY UPGRADE ND msg	NAV accuracy has been upgraded from LOW to HIGH.
NEW ACC ALT-HHHH	ACCeleration ALT is reassigned.
NEW CRZ ALT-HHHHH	CRZ ALT is redefined.
NEW THR RED ALT-HHHH	THRUST REDuction ALT is reassigned.
NO INTERSECTION FOUND	Two airways have no common waypoint.
NO NAV INTERCEPT	If NAV mode is armed and the current HDG/TRK does not intercept the Active Leg, Heading intervention is required.
NON UNIQUE ROUTE IDENT	An attempt was made to enter a CO RTE ident on the NEW ROUTE page that is identical to an existing CO RTE ident (pilot defined or database).
NOT ALLOWED	Data entry is not allowed in the selected field, or a selection action (LSK push/mode push) is not allowed.
NOT IN DATABASE	The entered CO RTE identification, From/TO pair, or place does not exist in the current database (including pilot defined elements).
ONLY SPD ENTRY ALLOWED	A MACH entry is attempted for a pre-selected speed value on the CLIMB page.
OPP FMGC IN PROCESS	The onside FMGC is inoperative and the FMGCs are operating in the single mode.
PILOT ELEMENT RETAINED	Attempt to erase all pilot waypoints from the pilot's database when one or more are being used by FMS.
PLACE/WPT MISMATCH	Attempt to insert specific distance to or from a specific waypoint over a different waypoint.
RESET IRS TO NAV	An INIT POSITION is present or has changed since IRS alignment, but none of the IRs are in ALIGN MODE. Message normally occurs when a new F-PLN has been entered if IRs have not been realigned.

MCDU Messages (continued)\

Messages (continued)

REVISIONS NOT STORED	Displayed when a pilot defined route or CO RTE (active or secondary F-PLN) is stored and indicates that the following elements are not stored: - pilot entered HOLDS - offsets - modifications to terminal area procedures - pilot entered constraints - FMGC created waypoints
RWY/ILS MISMATCH	The ILS frequency entered on the RAD NAV page does not match the selected runway.
SELECT DESIRED SYSTEM	The MCDU MENU page is displayed allowing the pilot to select the FMGC, ACARS, or CFDS system.
SELECT HDG/TRK FIRST	Attempting to modify the active leg while in NAV mode.
SENSOR IS INVALID	Displayed when the pilot selects FF, FQ, or FF+FQ on the FUEL PRED page and the sensor is invalid.
SET GREEN DOT SPEED PFD msg [SET GREEN DOT]	Displayed when all of the following conditions are met. - Engine out condition - Selected Speed mode - FCU Selected Speed equal or greater than green dot speed + 10 knots and ALT or ALT* not active, or less than or equal to green dot speed - 10 knots
SET HOLD SPEED PFD msg	A/C is in selected speed and is within 30 seconds of entering a HOLD. Condition is cleared when managed speed is activated.
SET MANAGED SPEED PFD msg	A/C is in selected speed and a pre-selected speed does not exist for the next phase of flight phase. Message appears at phase transition from CLB or CRUISE to DESCENT phase when in selected speed.
SPD ERROR AT WPT01	Displayed when operating in managed NAV and a speed constraint is predicted to be missed by more than 10 knots. The message clears when the error is reduced to be within 5 knots.
SPECIF NDB UNAVAIL	The desired NDB to be autotuned for the selected NDB approach has been deselected.
SPECIF VOR-D UNAVAIL ND msg	The desired VOR, VOR-DME, or VORTAC to be autotuned for the selected approach has been deselected.
SPD LIM EXCEEDED	The aircraft is more than 150 feet below the speed limit altitude and exceeds the speed limit by more than 10 knots.

MCDU Messages (continued)

Messages (continued)

Message	Condition
STEP ABOVE MAX FL	The pilot has entered a step altitude above the predicted MAX altitude.
STEP DELETED	Displayed when a step is deleted due to an Engine Out, insertion of another step, or a determination that the step cannot be flown (if the step is too near the top of descent).
STEP NOW	The aircraft is within 20 NM of the active step point.
STORED ROUTES FULL	3 pilot defined routes already exist (no more are allowed).
TIME CSTR DELETED	A time entry is made at a different waypoint on the same flight while another time constraint already exists.
TIME CSTR EXISTS	Attempt to erase an ETT computed by the FMS.
TIME ERROR AT WPT01	In lateral managed flight, a time constraint is predicted to be missed by more than 30 seconds.
TIME TO EXIT	The aircraft must leave holding immediately to satisfy fuel reserve requirements (i.e., EXTRA FUEL is zero).
TMPY F-PLN EXISTS	Displayed for any LSK selection except for ERASE or INSERT while the temporary F-PLN is displayed. The TEMP F-PLN must be inserted or erased before other MCDU entries can occur.
TOO STEEP PATH AHEAD	Displayed if within 150 NM of destination and in Managed NAV mode and there is a too steep path in the descent profile.
TUNE BBB FFF.FF	VOR for approach or position purposes, cannot be auto-tuned because of a manual VOR selection.
UNKNOWN PROGRAM PIN	System initialization fails due to an incompatible or undefined A/C program pin combination (A/C type, engine type with the FMGC software.
USING COST INDEX-NNN	A flight plan exists and a ZFW or GW is entered prior to defining a Cost Index (CI). The FMS provides a default CI if one is not entered by the pilot.
WAIT FOR SYSTEM RESPONSE	The subsystem page is displayed. Communication is currently being attempted but has not been established.
XXXX IS DESELECTED	An attempt has been made to enter a deselected navaid on the RAD NAV or PROG page.

RAD NAV Page

Radio Navigation Page

General

The radio navigation (RAD NAV) page is used to verify auto tuned navigation radio frequencies and courses, and manually tune desired navaids.

Autotuned frequencies and identifiers are displayed in small blue font. Pilot entries are displayed in large blue font.

All navaids can normally be tuned from either MCDU. During independent FMGC operation, the offside VOR cannot be tuned and the corresponding field is blanked.

If an identifier is entered for tuning, and more than one navaid shares that identifier, the DUPLICATE NAMES page is automatically displayed. Selection of the desired navaid from this page displays the RAD NAV page again.

Entering an identifier automatically displays the database frequency for that navaid. If the navaid is not in the database, the NEW NAVAIDS page is displayed.

Standby Navaid Tuning

If standby navaid tuning is selected on the Radio Management Panel (RMP), MCDU tuning of navaids is not possible (refer to chapter 34, Navigation: Standby Navaid Tuning). All data fields on the RAD NAV field are blanked when standby navaid tuning has been selected, as shown in the example.

Tuning a frequency via the RAD NAV page does not change the standby navaid frequency previously tuned on the RMP, or vice versa.

Manual Navaid Tuning

All navaids are tuned using the same procedure. The navaid can be tuned by:

- Entering the navaid identifier into the scratchpad, and then selecting the LSK adjacent to the desired navaid
- Entering the navaid frequency into the scratchpad, and then depressing the LSK adjacent to the desired navaid. A “/” is not required or allowed when entering the frequency.

RAD NAV Page (continued)

VOR 1/FREQ
FREQ/VOR2

These fields display the identifier and frequency of the navaids selected for display. The navaids can be a VOR, VOR/DME, DME only, or a VORTAC. During normal FMGC operations, VOR 1 is autotuned for display by FMGC 1, and VOR 2 by FMGC 2. During single FMGC operations, both VORs are tuned by the remaining FMGC.

The pilot can manually tune either VOR for display. This overrides autotuning. Either the identifier (e.g., DLL) or the frequency (e.g., 117.4) can be entered. A slash (“/”) is not required or allowed when entering the frequency because the FMGC recognizes the difference between the two entries.

Entering CLR in these fields deletes pilot entries and the auto tuned frequency and identifier is displayed.

CRS

These fields allow entry of a VOR course. The VOR course is displayed on the ND in the VOR ROSE mode (refer to chapter 31, Flight Instruments).

A course entered on VOR 1 can only be displayed on the captain's ND. The course for VOR 2 is only displayed on the first officer's ND.

If the VOR ident/frequency is changed, either manually or automatically, the course is erased.

This field is blank and no entry is allowed if an ident/frequency associated with a DME (only) is entered.

ILS/FREQ

This field allows entry of an ILS identifier or frequency. Autotuned ILS identifiers and the corresponding frequencies are displayed in this field.

Note: Both ILS receivers are always tuned to the same frequency and course. Therefore both ILSs are tuned with this field and only ILS 1 information is displayed on the RAD NAV page.

A slash (“/”) is not required or allowed when entering the frequency because the FMGC recognizes the difference between the two entries.

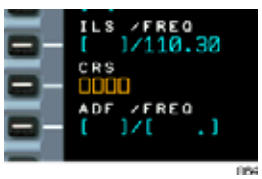
CRS

The CRS field below the ILS/FREQ field displays the final approach course for ILS and localizer type navaids.

When an ILS identifier is manually or autotuned, the database course associated with that approach is automatically displayed.

The course cannot be modified when the ILS has been tuned with an identifier.

When an ILS has been manually tuned using the frequency, amber boxes appear requesting the pilot to enter a course.



The ILS course is preceded with an F for a front course or a B for a backcourse. When manually entering a course, if a prefix letter is not specified, F is the default.

RAD NAV Page (continued)

ADF /FREQ

This ADF/FREQ field displays the identifier and frequency of the NDB tuned for display and allows manual tuning of the ADF receiver.

The ADF can be manually tuned by entering either the station IDENT or frequency. A slash (“/”) is not required or allowed when entering the frequency because the FMS recognizes the difference between the two entries.

If a manual entry has not been made, the FMS will automatically tune the ADF by decreasing order of priority:

- If an NDB approach is selected and the TO waypoint belongs to that approach, when the aircraft is in the terminal area (51NM), the specified NAVAID will be tuned
- If the TO waypoint is an NDB, the FMS will tune it
- If the from waypoint is an NDB, the FMS will tune it

If the ADF has been manually tuned and the FMS finds that according to the first rule above, a different NAVAID should be tuned, the message TUNE OR 384.0, (OR being the two letter identifier and its’ associated frequency), will be displayed in the scratchpad as indicated in the following illustration;

ADF 1 BFO

When an ADF identifier or frequency has been selected, this prompt appears. The beat frequency oscillator (BFO) can be selected, enabling more precise tuning of the signal.

Intentionally Left Blank

FUEL PRED Page

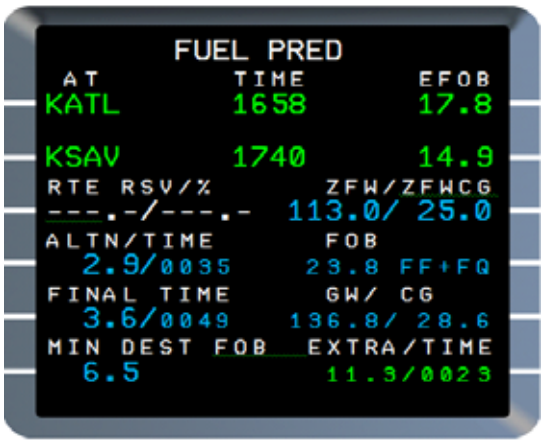
Fuel Prediction Page

General

The fuel prediction (FUEL PRED) page displays fuel and time predictions and data pertaining to the primary flight plan.

Much of the data on the FUEL PRED page is identical to that found on the INIT page B. If the INIT page B is displayed prior to engine start, the FUEL PRED page is automatically displayed upon start of the second engine.

The FUEL PRED page displays fuel planning data after the preflight phase (engine start), since the INIT page B is not available.



AT, UTC, EFOB

Line 1 and 2 display predictions for time and fuel at the planned destination and alternate airports. When on the ground, the data labeled UTC displays the estimated time en route (ETE) and estimated fuel on board (EFOB) at the destination.

If an estimated takeoff time (ETT) has been entered (via a flight plan vertical revision at the departure airport), the time is the estimated time of arrival (ETA). An ETT entry is discussed in detail in the previous Vertical Revisions page section.

When airborne, UTC displayed is GMT and the predictions are ETA and EFOB at the destination via the flight plan routing.

If a destination is not entered in the flight plan, NONE is displayed in 1L and the prediction fields are dashed.

Alternate Predictions

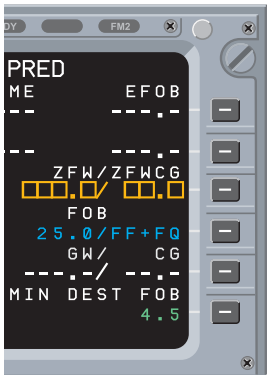
The alternate destination is displayed at 2L. The predicted ETA at the alternate is displayed in the UTC field. The predicted EFOB at the alternate is displayed at 2R. Both of these predictions use the alternate routing entered in the flight plan from the primary destination to the alternate.

If no alternate has been specified, NONE is displayed in the field and the prediction fields are dashed.

FUEL PRED Page (continued)

ZFW/ZFWCG

The pilot enters the aircraft zero fuel weight (ZFW) and zero fuel weight center of gravity (ZFWCG) into the amber boxes either on the INIT B page prior to engine start, or the FUEL PRED page aferwards. (Values are entered in the form “115.0/28.6” from the load advise). Once entered on the FUEL PRED page, the FMS will add the fuel quantity value to automatically compute the aircraft gross weight and center of gravity (GW and CG) displayed on line 4R. Aircraft weight data can be entered only on the FUEL PRED page after engine start. In this case, amber boxes will be displayed, along with the message INITAILIZE WEIGHTS displayed in the scratchpad.



F340422C

Aircraft weight is required for autothrust managed speeds to function (refer to Chapter 22, Autoflight). A correct ZFW/ZFWCG can be entered in this field at any time.

The flight augmentation computers (FACs) independently compute aircraft gross weight and CG when airborne. If a significant difference exists between the FMS gross weight or CG displayed on this page and the FAC calculated gross weight and/or CG, a CHECK WEIGHT message is displayed.

The aircraft zero fuel weight center of gravity (ZFWCG) can be modified in this field. If only a ZFWCG entry is desired, it must be preceded by a “/” (e.g., “/24.4”).

FOB

The present fuel on board (FOB) is displayed. Fuel on board may be changed by entering the correct value at any time. If the fuel on board data is lost by the FMS, amber boxes are displayed.

Fuel on board is normally calculated using both fuel flow (FF) and fuel quantity (FQ) sensors. The current sensors in use are displayed after the “/” (e.g., Fuel Quantity+ Fuel Flow or FQ+FF). If a sensor is known to be invalid, the pilot enters the operational sensor after the “/”. For example, if a fuel quantity gauge is inoperable, a “/FF” entry would make the FMS use fuel flow only when calculating fuel on board

Entering “/CLR” into 3R results in FF+FQ being displayed.FUEL PRED Page.

FUEL PRED Page (continued)

RTE RSV/%

The desired route reserve (RTE RSV) fuel or percentage is entered in this field. One is entered and then the other is calculated. Entries can be either a fuel amount or percentage.

Pilot data entries are displayed in large font, with calculated data displayed in small font. A percentage entry requires a “/” prior to the desired percentage. Percentages can range from 0 to 15%

Any attempt to enter both RTE RSV and % at the same time is rejected and the FORMAT ERROR message is displayed in the scratchpad.

If nothing is entered into either field, the default value is 15% of the trip fuel.

ALTN/TIME

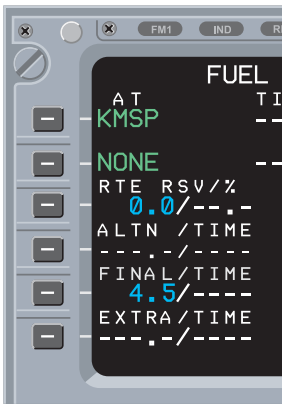
If an alternate airport has been entered in the flight plan, the FMS will calculate the required fuel and time to reach the alternate via the routing specified in the flight plan. If no routing is specified, the FMS will calculate the fuel burn based on a direct route.

Alternatively, the pilot can enter a fixed fuel burn or time to reach the alternate into these fields.

FINAL/ TIME

The FINAL/TIME field displays the desired arrival fuel quantity or time at the destination airport. When an entry is made in one field, the other is automatically calculated and displayed in small font.

When entering only a time value, fuel calculations are based on holding at 1500 feet above the destination airport (or alternate airport, if defined), in the clean configuration at green dot speed.



F340423C

MIN DEST FOB

The sum of the ALTN and FINAL FUEL and represents the minimum fuel value required at destination airport and have enough fuel to proceed to the alternate and keep the Reserve Fuel (3.6 in this case) intact.

EXTRA/TIME

This field displays extra fuel and time available after subtracting the taxi, trip, reserve, alternate, and final fuel values from the block fuel.

This field cannot be directly modified by the pilot. However, if another field is modified (for example FINAL fuel), the calculated EXTRA fuel increases or decreases accordingly.

A negative EXTRA fuel quantity indicates that the fuel on board is less than that required by the displayed amount. The flight plan and alternate routing should be verified, along with the entered values in the RTE RSV and FINAL fields.

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SEC F-PLN Pages

Secondary Flight Plan Pages

General

The SEC INDEX (secondary index) page is a flight planning tool that allows the pilot to plan and store a flight plan in addition to the active primary flight plan. Most of the flight planning features available in the active flight plan are available in the secondary flight plan. In the SEC INDEX you can:

- Copy the active flight plan and then modify it if necessary
- Enter a secondary flight plan manually.

Examples of uses for the secondary flight plan are:

- Copying the active flight plan for reference when flying a direct routing,
- Designating a second runway and/or approach option at the primary destination,
- Stringing a route to a second alternate airport.

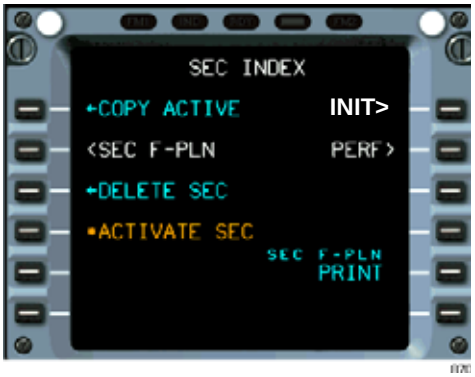
A route completely different from the active primary flight plan, such as the next leg of the flight, may also be created and stored in the secondary flight plan.

Note: The secondary flight plan from the previous flight is retained until replaced, deleted or if an aircraft power cycle occurs.

Selecting the SEC F-PLN key allows the white secondary flight plan to be displayed on the ND simultaneously with the active flight plan. Only legs that are different are displayed.

SEC INDEX Page

The secondary index (SEC INDEX) is displayed when the SEC F-PLN key is selected. The prompts on this page vary depending on the status of the secondary flight plan. The page displayed below shows all of the possible prompts on this page.



Secondary Flight Plan Pages (continued)

COPY ACTIVE

This prompt copies the active flight plan. The previously stored secondary flight plan is erased and replaced with the active flight plan.

The secondary flight plan (SEC) page is automatically displayed after the COPY ACTIVE prompt is selected. All data on this page is displayed in white. Display format and flight plan modification rules are the same as for the active flight plan.

SEC F-PLN

This prompt displays the secondary flight plan in white on the MCDU and ND. On the ND legs in the secondary flight plan which are different from the active flight plan are displayed in white. Displaying the secondary flight plan does not affect engaged flight guidance modes or the current routing of the aircraft.

DELETE SEC

Selecting this prompt deletes the stored secondary flight plan. It is not necessary to delete the previous flight plan before storing a new secondary flight plan.

ACTIVATE SEC

Selecting the ACTIVE SEC prompt replaces the active flight plan with the secondary flight plan. The amber prompt indicates that a significant action will occur if the prompt is selected. Recovery of the active flight plan is not possible after activating the secondary.

Note: This prompt is not available if:

- A secondary flight plan does not exist
- The active flight guidance mode is NAV. If it is necessary to replace the active flight plan with the secondary, engaging the heading/track (HDG/TRK) mode allows this prompt to appear

INIT

The INIT prompt displays the INIT A and INIT B pages for the secondary flight plan. This prompt allows the pilot to access the secondary initialization pages and manually enter a secondary flight plan. This procedure is used when storing a secondary flight plan that has different departure and/or destination airports from the active flight plan.

PERF

This prompt is available when a secondary flight plan exists, and accesses the secondary performance (PERF) pages. These pages are identical to the active flight plan performance pages, except that blue brackets replace amber boxes. Predictions are not available on the secondary performance pages.

Secondary Flight Plan Automatic Erasure

Each leg in the secondary flight plan automatically erases if it is identical to the active flight plan. The secondary flight plan does not erase after any point where it differs from the active flight plan.

MCDU MENU Page

General

The MCDU menu page is accessed by selecting the MENU key. Systems that are linked to the MCDU may be accessed with this page. The name of the current system is displayed in green, all other are white.

If the RETURN prompt is selected, the display returns to the active system. Selecting a prompt adjacent to a system displayed in white selects that system.

When a system requests pilot attention, the page displays REQ next to the system name and the MCDU MENU annuciator illuminates. The light extinguishes when the LSK of the requesting system is selected.

If any other system is using the MCDU, pressing any MCDU mode key (F-PLN, PERF, etc.) returns the display to the corresponding FMGC page.

FMGC

The FMGC prompt provides access to the Flight Management functions of the associated Flight Management Guidance Computer

ACARS

The ACARS prompt provides access to the ARINC communication and reporting system.

AIDS

The AIDS prompt provides assess to the aircraft interrogation data system.

CFDS

The CFDS prompt provides access to the Central Fault Display system. This prompt is only on the first officers MCDU. This is normally a maintenance function.

RETURN

The RETURN prompt returns the pilot to the previous page.

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Chapter 35: Oxygen

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Crew Oxygen Stowage Box Controls 35.20.8

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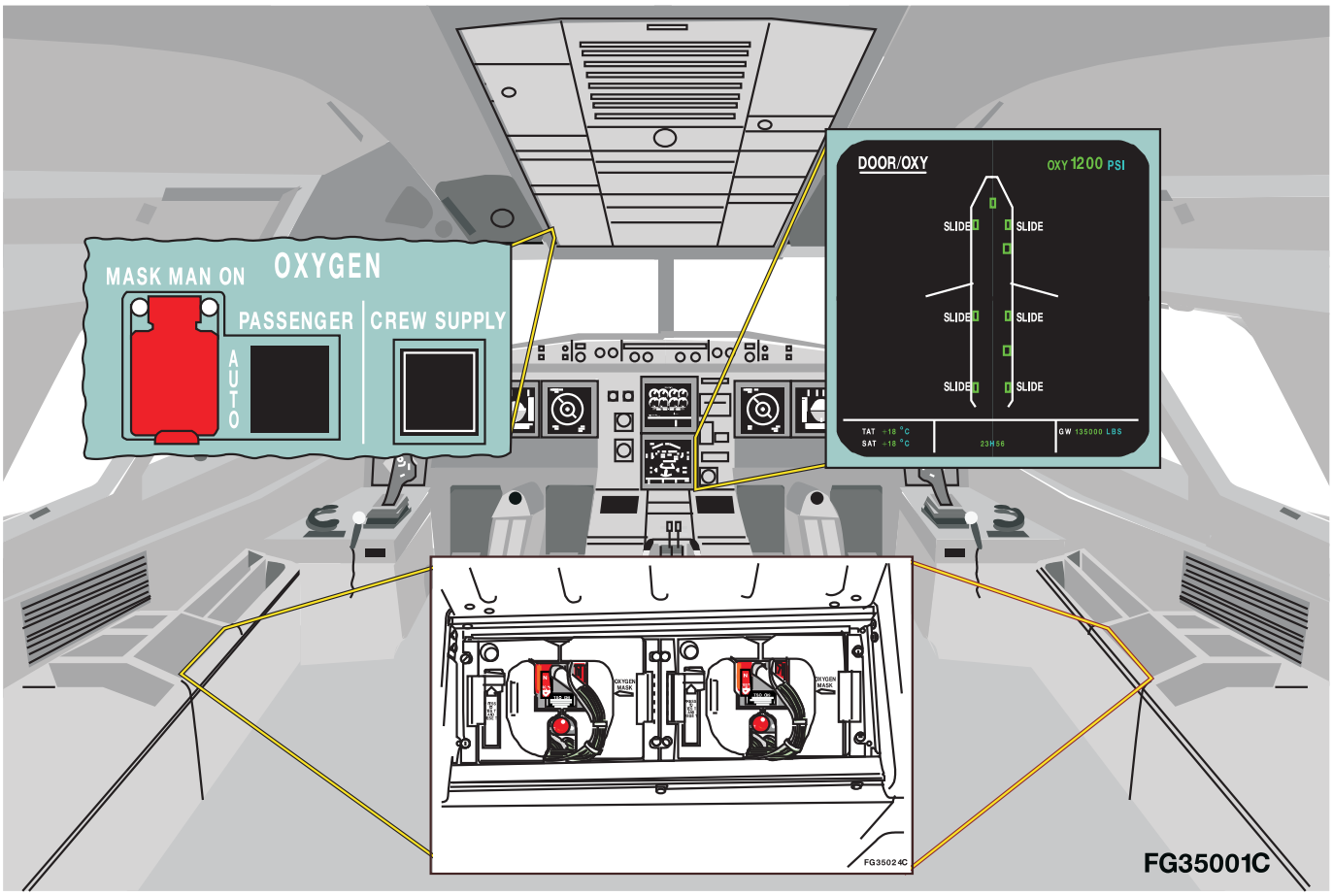
System Description

Location of Oxygen System Components

Introduction The oxygen system components are shown below.



General Description

Purpose

The A319/320 oxygen system provides supplemental breathing oxygen to the flight deck or cabin when ambient air is not suitable for breathing.

System Breakdown

There are three independent supplemental oxygen systems installed on the A319/320:

- flight deck fixed (crew) oxygen system for the flight crew,
- cabin fixed oxygen system for the passengers and flight attendants, and
- portable oxygen system for the flight crew, flight attendants, and passengers.

Oxygen Sources

The oxygen sources for each independent system are:

- an oxygen cylinder for the flight deck fixed oxygen system,
- chemical generators for the cabin fixed oxygen system, and
- portable oxygen bottles for the portable system.

Crew Oxygen System

Introduction

The crew oxygen system consists of a high pressure oxygen cylinder which supplies four quick donning oxygen masks. Controls are provided on the overhead panel and on the masks.

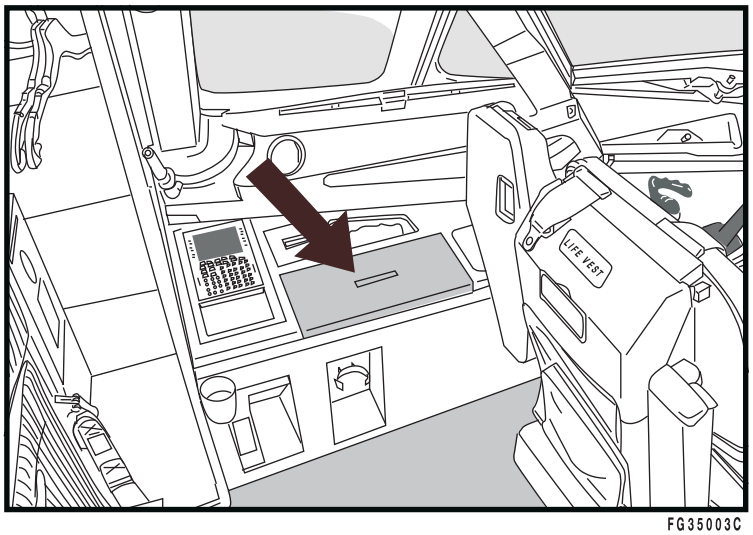
The following components are located in the avionics bay and are not accessible to the pilot:

- the oxygen cylinder,
- the high pressure regulator, and
- on/off oxygen solenoid.

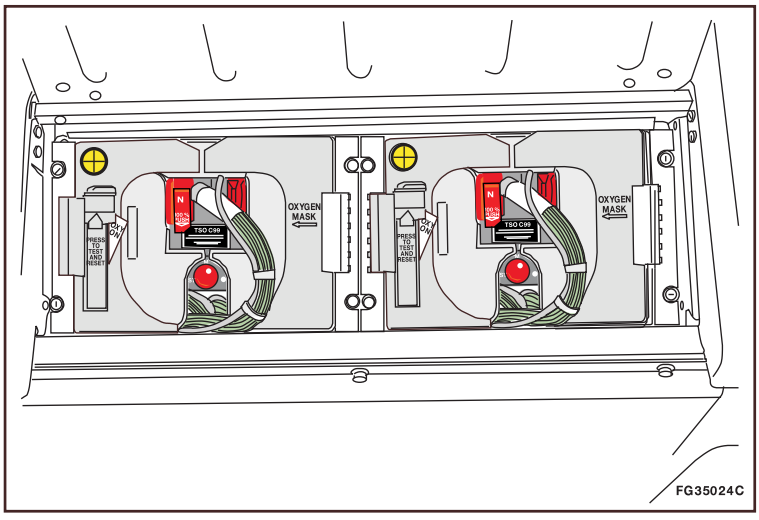
Mask Location

The crew oxygen masks are located on the lateral pedestal for each pilot. There are four masks, two on each side of the cockpit, one for each seat.

One box on each side of the cockpit



Two masks in each box



Crew Oxygen System (continued)

Oxygen Mask Storage Box Controls

Each oxygen mask's air flow and communication capabilities can be tested with out removing the mask from its respective storage box.

Oxygen Flow

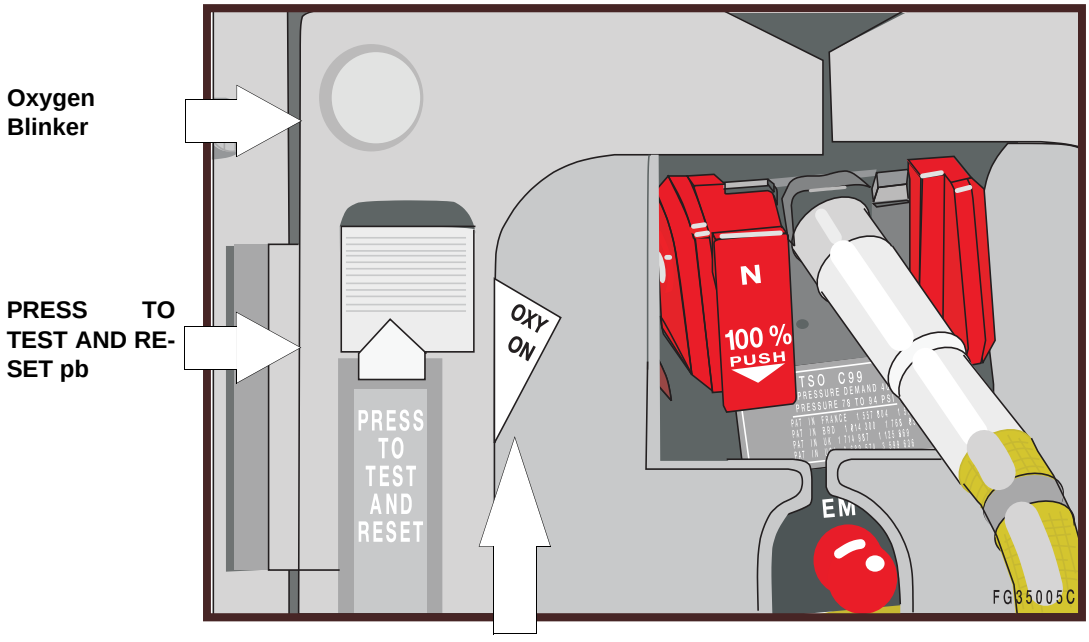
Pushing the PRESS TO TEST AND RESET pb releases a momentary surge of oxygen to the mask. This causes the oxygen blinker to open momentarily. A satisfactory test for oxygen flow results in the blinker opening when the PRESS TO TEST AND RESET pb is pushed.

Mask Communication

The oxygen mask's microphone is tested by monitoring the interphone system, then pushing the PRESS TO TEST AND RESET pb and the emergency selector pb simultaneously. The noise of rushing air heard over the flight deck speaker validates the operation of the microphone.

Note: The microphone installed in the fourth occupant's oxygen mask is not operational.

Additionally, a white OXY ON flag is provided to alert the pilot that the oxygen mask microphone has been activated and the oxygen supply to the mask is ON. The flag can be reset by pushing the PRESS TO TEST AND RESET pb.



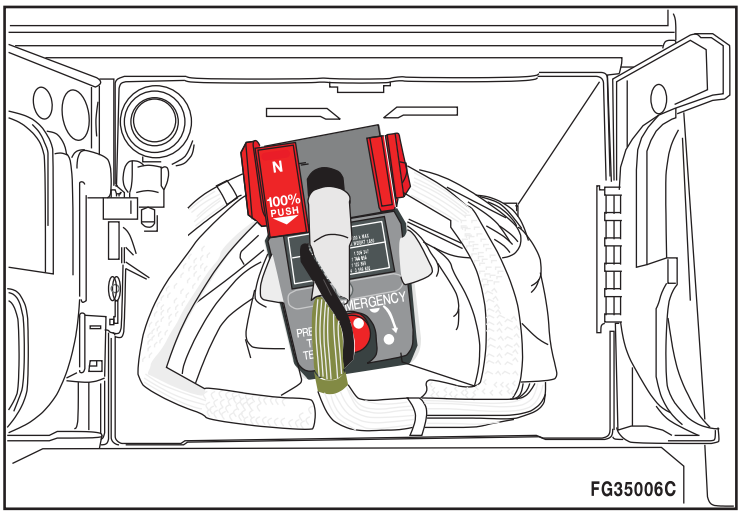
Crew Oxygen System (continued)

Normal Mask Operation

The oxygen masks are quick-donning and are designed to fit over normal eye wear.

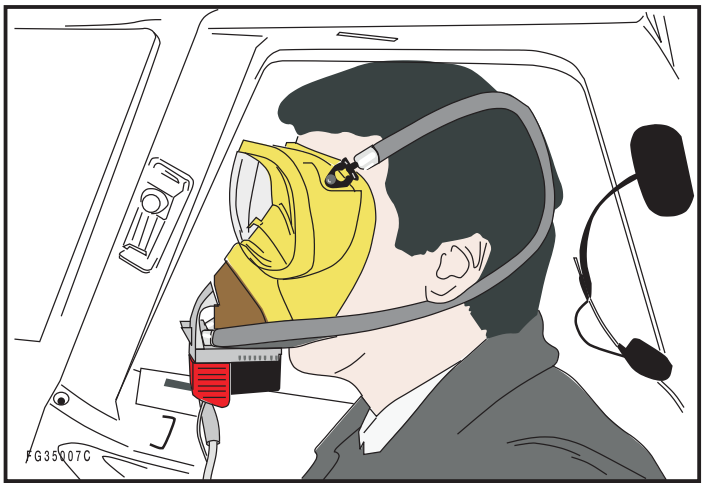
Removal

Remove the mask by squeezing the red grips on the front of the mask and pulling upward.



Donning

Don the mask by continuing to squeeze the red grips, which causes oxygen pressure to inflate the head harness. Next, fit the harness over the head. When the mask is in place release the red grips.



Replacement

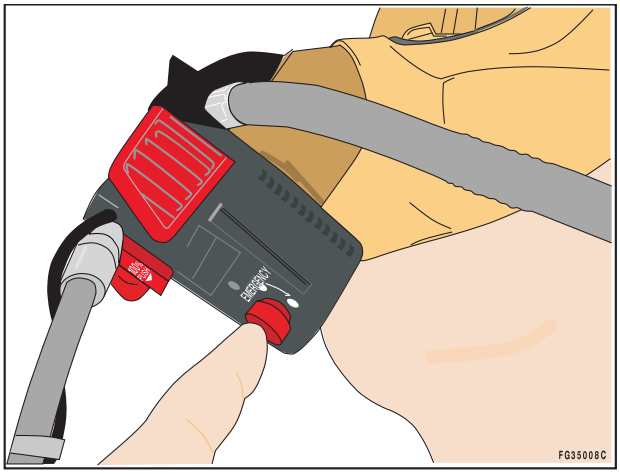
Replace the mask by fitting the mask back into the box with the red grips up and exposed. When the mask has been stowed, close the doors and press the PRESS TO TEST AND RESET pb to de-energize the microphone in the oxygen mask.

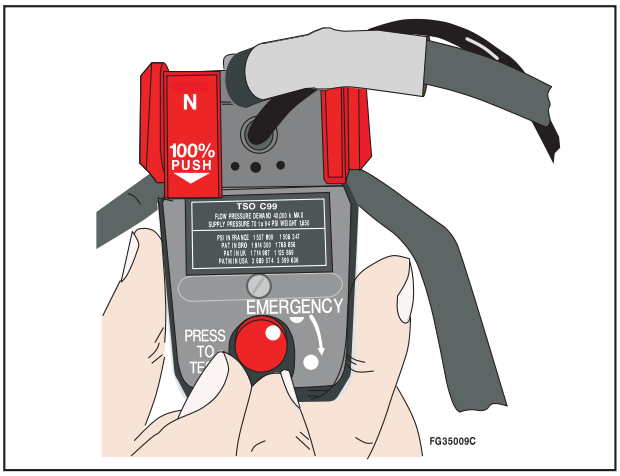
Crew Oxygen System (continued)

Emergency Use

In the event of an emergency that requires the use of crew oxygen, the mask is removed and donned.

If conditions require a positive mask pressure, rotate the emergency selector on the front of the mask one third of a turn clockwise. The mask then provides positive pressure oxygen that does not require inhaling to trigger the oxygen flow.





Cabin Oxygen System

Introduction

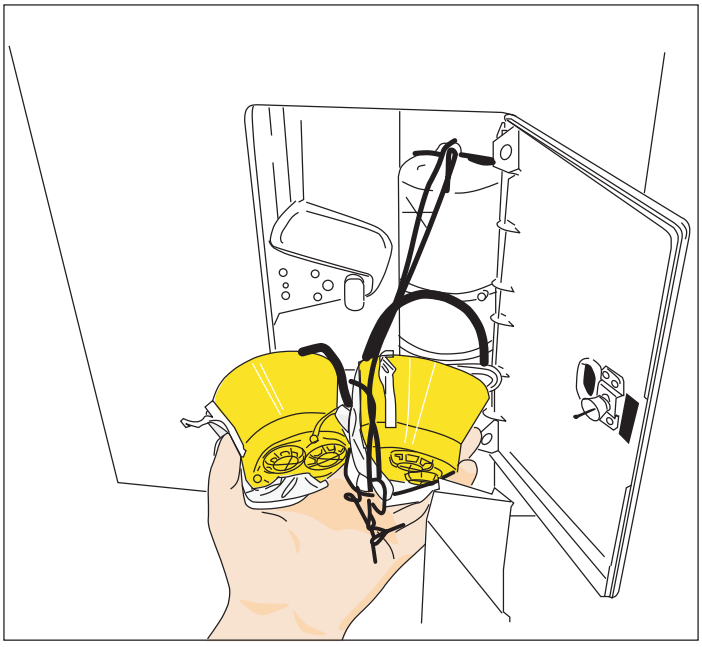
The cabin oxygen system consist of individual self-contained chemical oxygen generators located at stations throughout the passenger cabin.

Each chemical oxygen generator provides approximately a 15 minute supply of pure oxygen under pressure and, must be manually activated by the user.

Depending on station location, each oxygen generator may have 2, 3, or 4 masks connected to it. Oxygen generators are located:

- above each passenger seat row,
- in each lavatory,
- at each galley, and
- at each flight attendant station.

Note: When activated, oxygen generators become extremely hot. As a result, an odor, similar to scorched cotton, will be present. In addition, there may be a smoky haze in the cabin.



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Cabin Oxygen System (continued)

Cabin Oxygen Mask Deployment

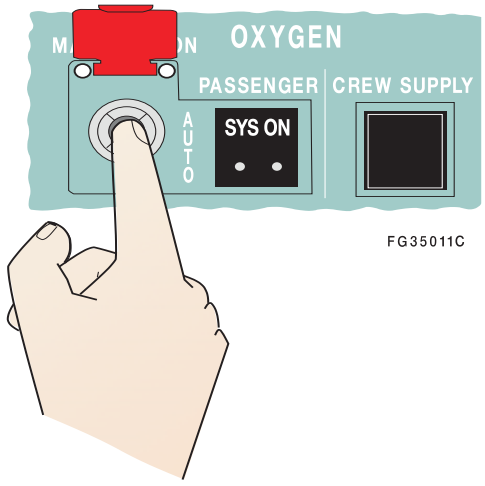
Cabin oxygen masks are stored in compartments throughout the cabin. Each compartment is equipped with a door which, when opened, allows the masks to deploy.

When cabin altitude exceeds14,000 feet, the oxygen mask storage compartment doors automatically open, allowing the masks to deploy. The doors can also be manually commanded to open by pushing the MAN ON pb, located on the oxygen panel of the flight deck.

Whether the compartment doors have been automatically or manually commanded open, a SYS ON light on the oxygen panel illuminates.

Note: Illumination of the SYS ON light is not an indication that all the masks have actually deployed or are being utilized. It simply indicates that an electrical signal has been sent to open the compartment doors.

.



Oxygen Generator Activation

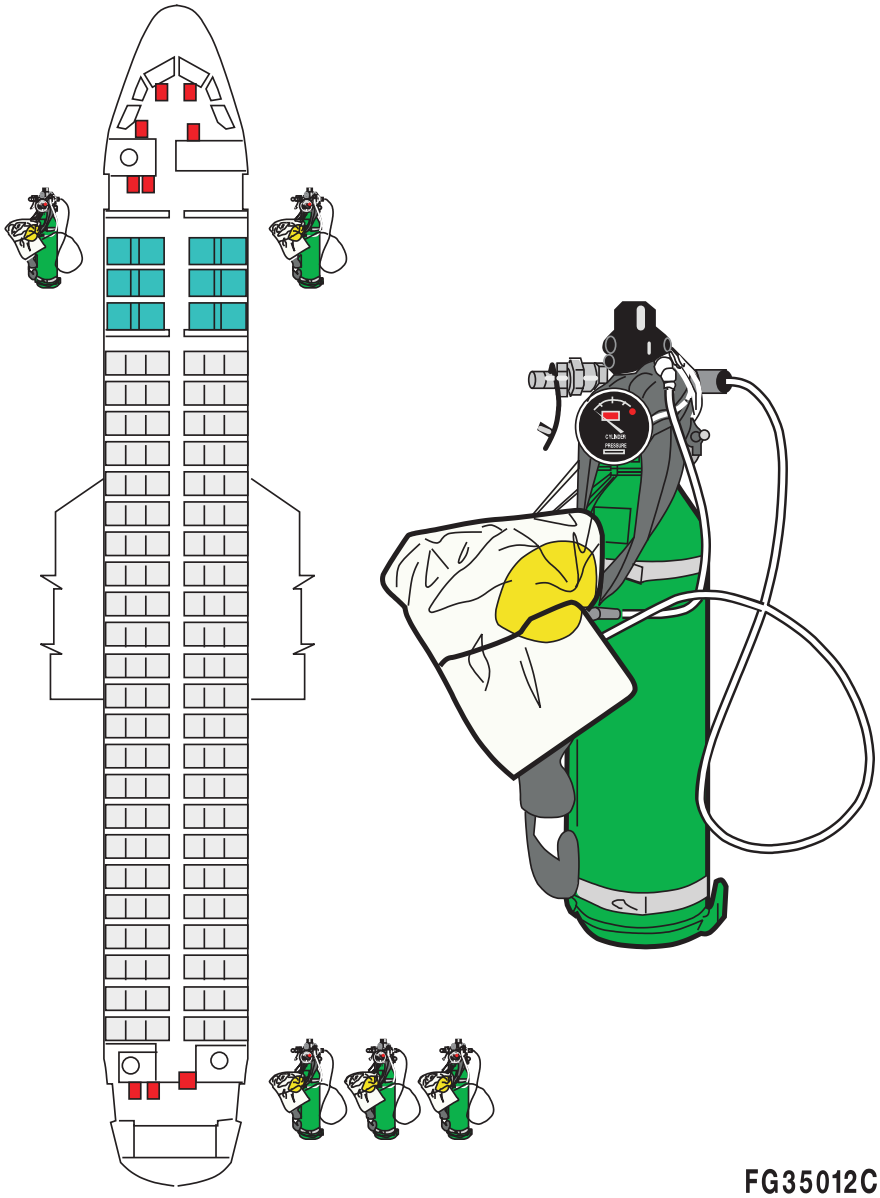
Oxygen generators are manually activated by the user by forcefully tugging on any one of the connected oxygen mask hoses. Once activated, oxygen will flow to each mask whether it is being utilized or not.

Portable Oxygen System

Portable Oxygen Bottles

Five portable oxygen bottles are available for first aid use or as walk-around units following a cabin pressure loss. Each bottle has a mask attached. Each bottle supplies oxygen for approximately 65 minutes.

Two portable oxygen bottles are stored in an overhead bin located in the first class section. The three remaining bottles are located in the most aft left hand side passenger overhead storage bin.



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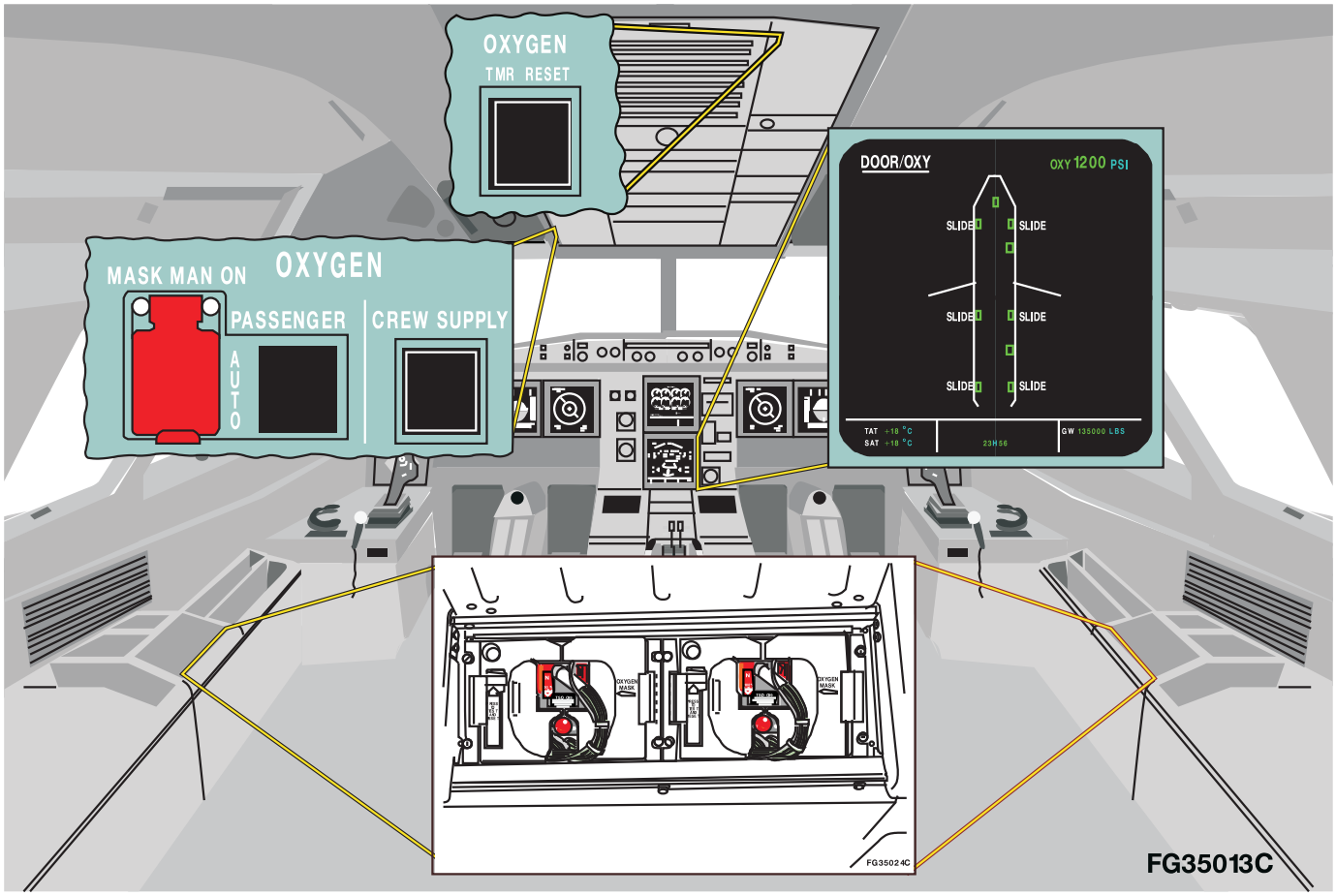
Controls and Indicators

Location of Controls and Indicators

Introduction

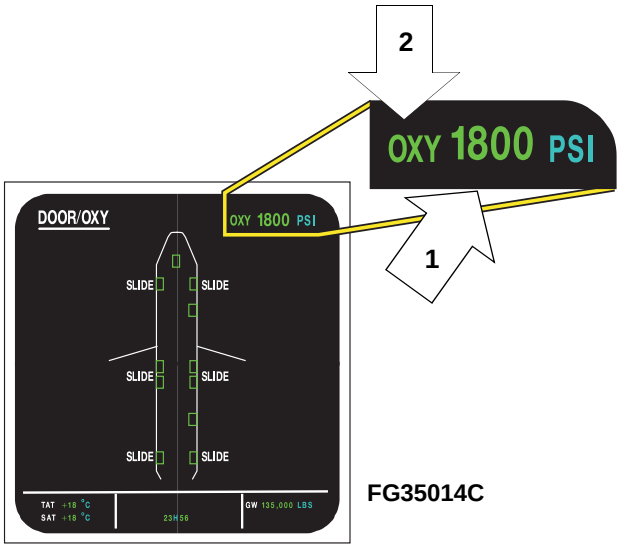
Controls and indicators for the oxygen system are located in the flight deck, as shown below:



ECAM DOOR/OXY Page

Indications

The ECAM DOOR/OXY page provides crew oxygen information in the upper right corner.



FG35014C

1. Cylinder Pressure

The value indicates the cylinder pressure. The value is green when the pressure is normal. If the pressure indication is green and has an amber half frame around the value, the pressure is below 1,500 psi.

FG35025C

The OXY pressure indication changes to amber when the pressure is less than 400 psi.

02/01 F350001C

2. OXY

The indication is normally green. The green indication, in combination with lights out on the CREW SUPPLY pb, indicates the oxygen system is on.

The indication becomes amber when:

- there is insufficient oxygen bottle pressure or
- OXYGEN CREW SUPPLY pb is OFF.

FG35027C

ECAM DOOR/OXY Page (continued)

REGUL LO PR

01/01 F350002C

This message appears amber if inadequate pressure is being delivered to the mask. This may be caused by:

- CREW SUPPLY pb is selected OFF, or
- inadequate oxygen cylinder pressure with CREW SUPPLY pb ON.

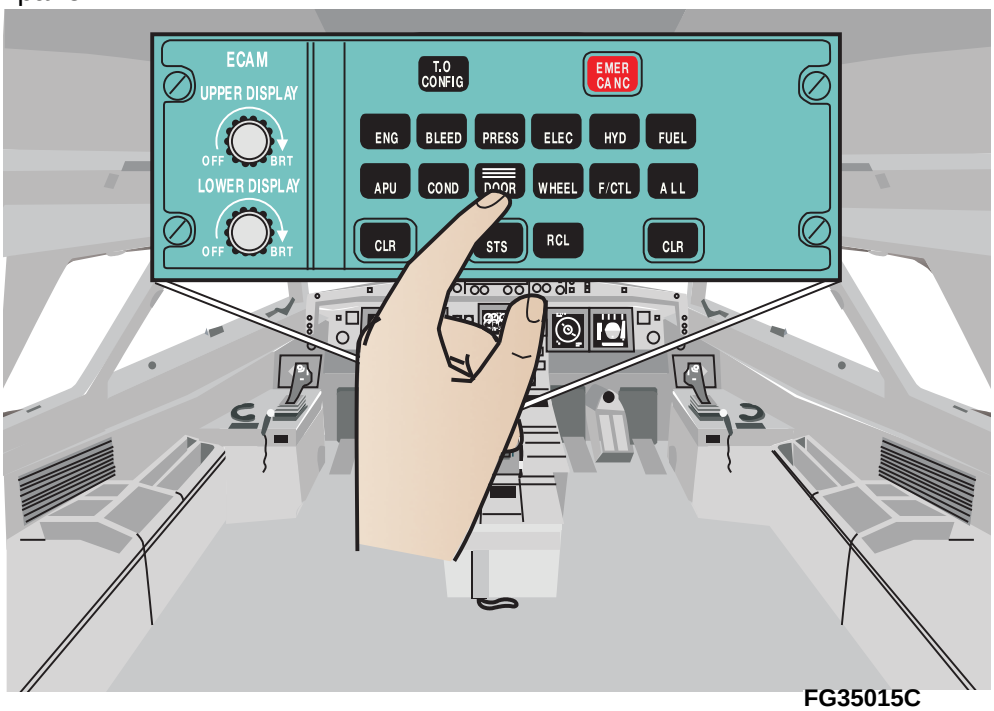
Hi Pressure Oxygen Regulator

The pressure regulator is mounted in the oxygen line between the oxygen cylinder and the masks. Its purpose is to reduce high cylinder pressure into useable mask pressure.

The numeric pressure indication on the upper right corner of the ECAM DOOR/OXY page is read from the high pressure side of the pressure regulator. The REGUL LO PR indication is read from the low pressure side of the pressure regulator.

ECAM DOOR/OXY System Page

The DOOR/OXY page automatically appears on the ground when no other page has priority. The page may be selected manually by pushing the DOOR pb on the ECAM control panel.

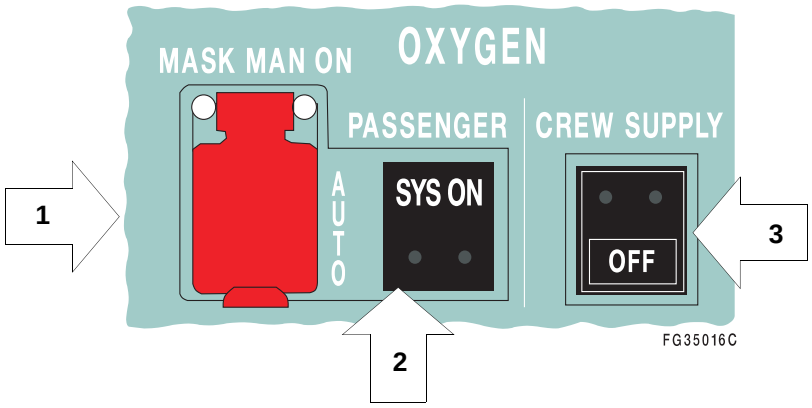


FG35015C

OXYGEN Panel

Function

The OXYGEN panel is located on the left overhead panel. This panel shares controls for both the crew and passenger oxygen systems.



1. MASK MAN ON pb

AUTO (guarded)

The oxygen mask doors open automatically when the cabin altitude exceeds approximately 14,000 ft.

Pressed (guard lifted)

Manually sends a signal to deploy the cabin oxygen masks.

2. PASSENGER SYS ON Light

The light illuminates white when either an automatic or manual signal has been sent to deploy the masks. The light remains illuminated unless the TMR RESET pb is activated (see next page).

3. CREW SUPPLY pb

This pb controls the crew oxygen low pressure supply valve.

ON (lights out)

The valve is open and low pressure oxygen is supplied to the masks. An associated ECAM indication appears on the DOOR/OXY page.

OFF

The valve is closed. A REGUL LO PR ECAM indication appears on the DOOR/OXY page.

OXYGEN Panel (continued)

OXYGEN TMR RESET pb

The OXYGEN TMR RESET pb is located on the aft section of the overhead panel.

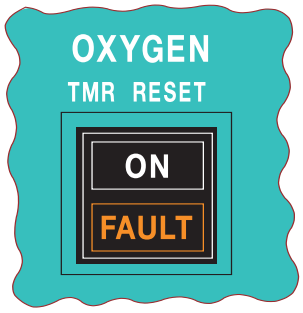
ON

When the pb is selected ON, the white ON light illuminates. When the pb is released, the white ON light extinguishes.

Momentarily selecting the pb to ON after the passenger oxygen masks have been deployed, resets the mask deployment system timer and causes the PASSENGER SYS ON light on the OXYGEN control panel to extinguish.

FAULT

FAULT illuminates when the signal sent to the passenger oxygen mask doors is not automatically de-energized after a preset time.

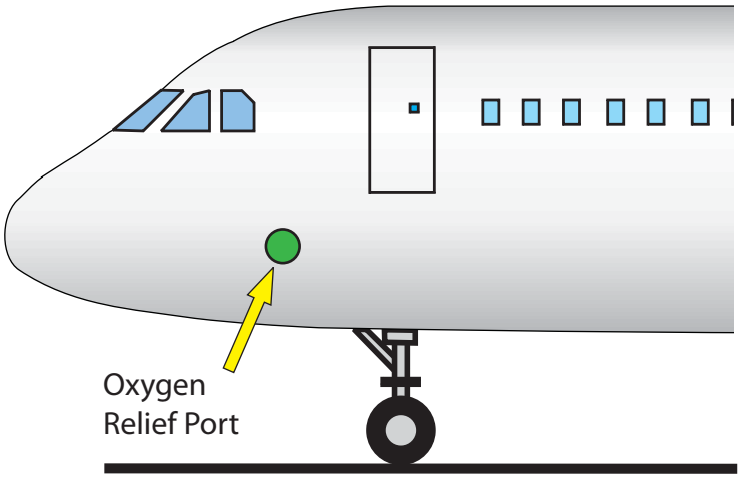


FG35017C

Aircraft External Oxygen Indicator

Description

An oxygen bottle relief port is located on the left forward side of the aircraft exterior. Absence of a green plug in this port indicates the crew oxygen has depleted due to thermal expansion.



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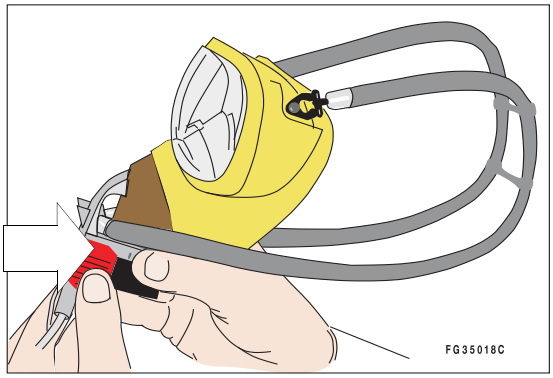
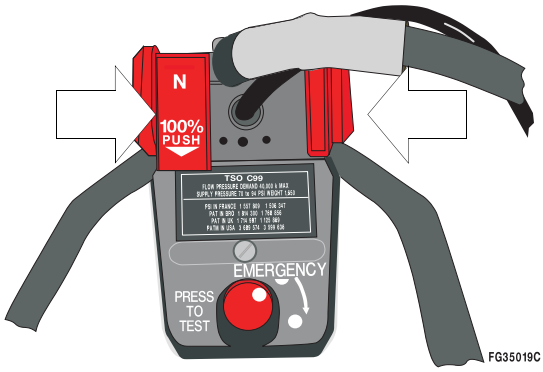
Crew Oxygen Mask Controls

Red Grips

Squeezing the red hand grips inflates the harness when the mask is removed from the storage box.

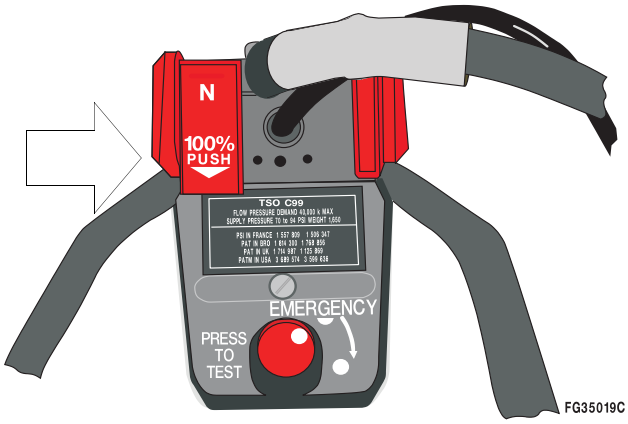




N/100% Selector

100%

The mask delivers 100% oxygen. When lifted, the regulator returns to the N position.



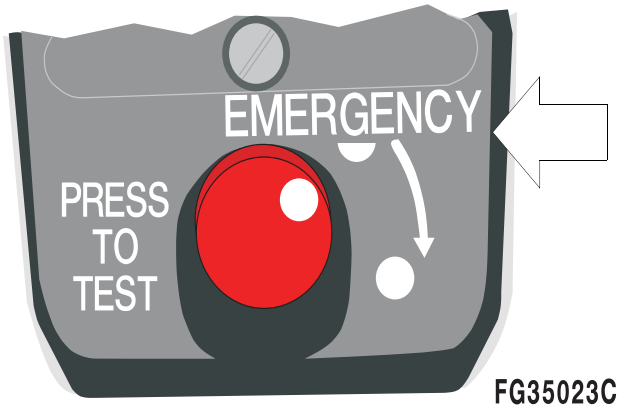
N

In the Normal position, a variable ratio of ambient air and oxygen is delivered to the mask. Above 35,000 ft, the air inlet is closed to provide 100% oxygen supply.

Note: Delta procedure is to preflight the selector in the 100% setting at all times.

Crew Oxygen Mask Controls (continued)

EMERGENCY pb



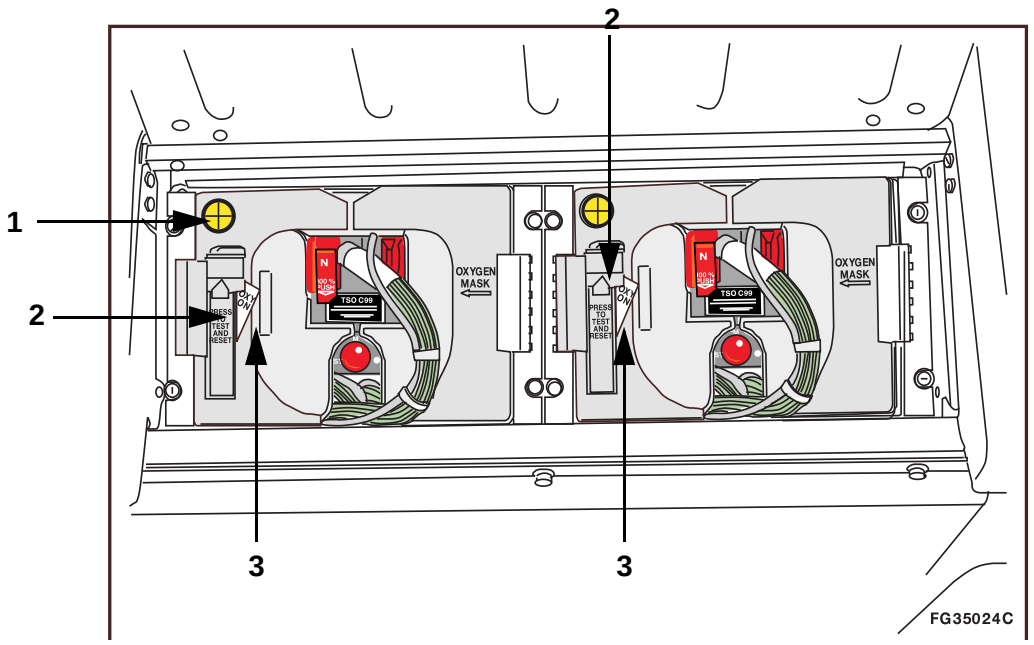
When the pb is pressed, a positive flow of oxygen is supplied to the mask. The flow returns to demand when the pb is released.

When the pb is rotated to the non-emergency position (counterclockwise), the pilot must inhale to receive oxygen.

When the pb is rotated to the EMERGENCY position (clockwise), a continuous positive oxygen pressure is supplied to the mask. This position is used if the mask regulator fails or the mask needs to be purged of toxic fumes.

Crew Oxygen Stowage Box Controls

Location

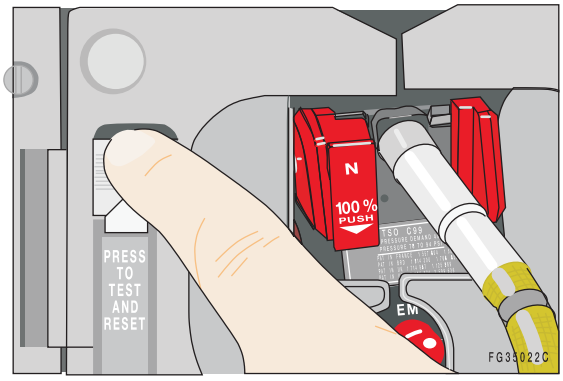


1. Blinker

This blinker opens when air/oxygen is flowing to the mask.

2. PRESS TO TEST AND RESET pb

This pb will test blinker operation, regulator supply, system sealing downstream of the valve, regulator sealing, and operation.



Pressing the RESET pb after using the oxygen mask cuts off the oxygen microphone and oxygen flow to the mask. The OXY ON flag is stowed.

3. OXY ON Flag

Appears when the oxygen supply is opened and the left door is closed. The flag indicates that the microphone in the oxygen mask has been activated.

Chapter 36: Pneumatics

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System Description

General Description

Introduction

The pneumatic system is designed to provide air pressure for the following:

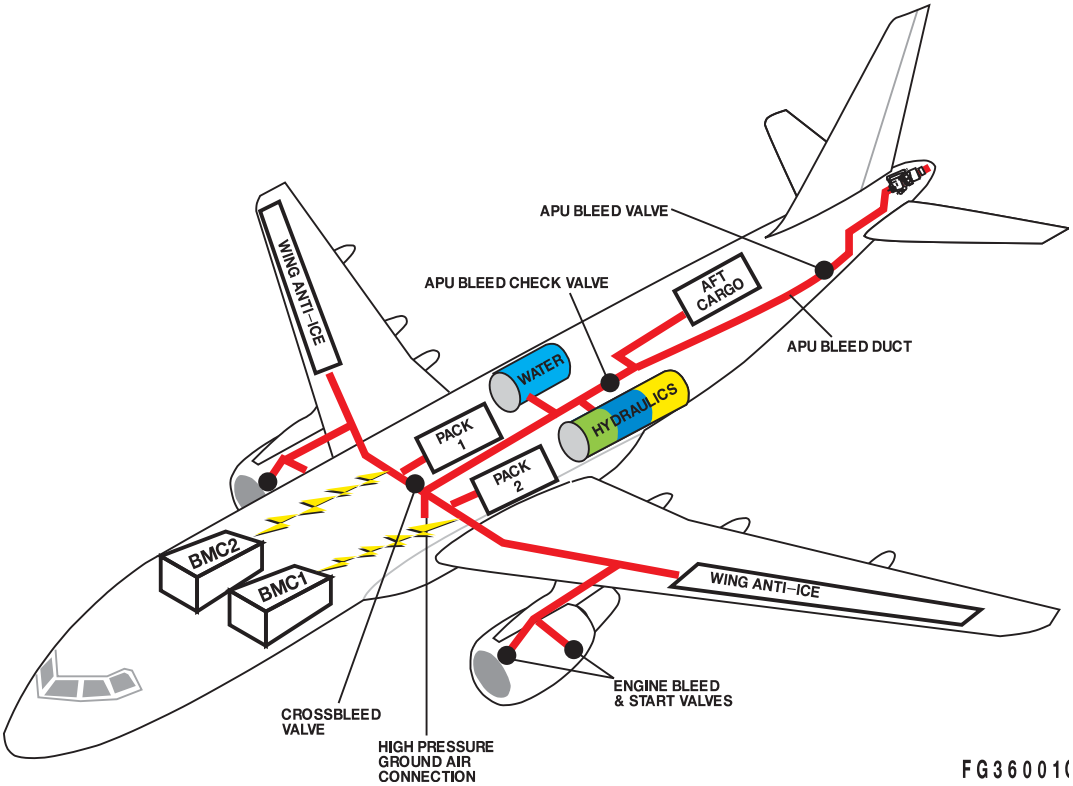
- air conditioning,
- engine starting,
- wing anti-icing,
- water pressurization (early models only), and
- hydraulic reservoir pressurization.

System Breakdown

The pneumatic system is composed of:

- two bleed monitoring computers (BMCs),
- one crossbleed valve,
- engine bleed and engine start valves,
- one APU bleed valve, and
- leak detection loops.

The diagram below illustrates the major components of the pneumatic system. The valves are depicted on the ECAM system display pages.



Air Sources

Description

High pressure air can be supplied from three sources:

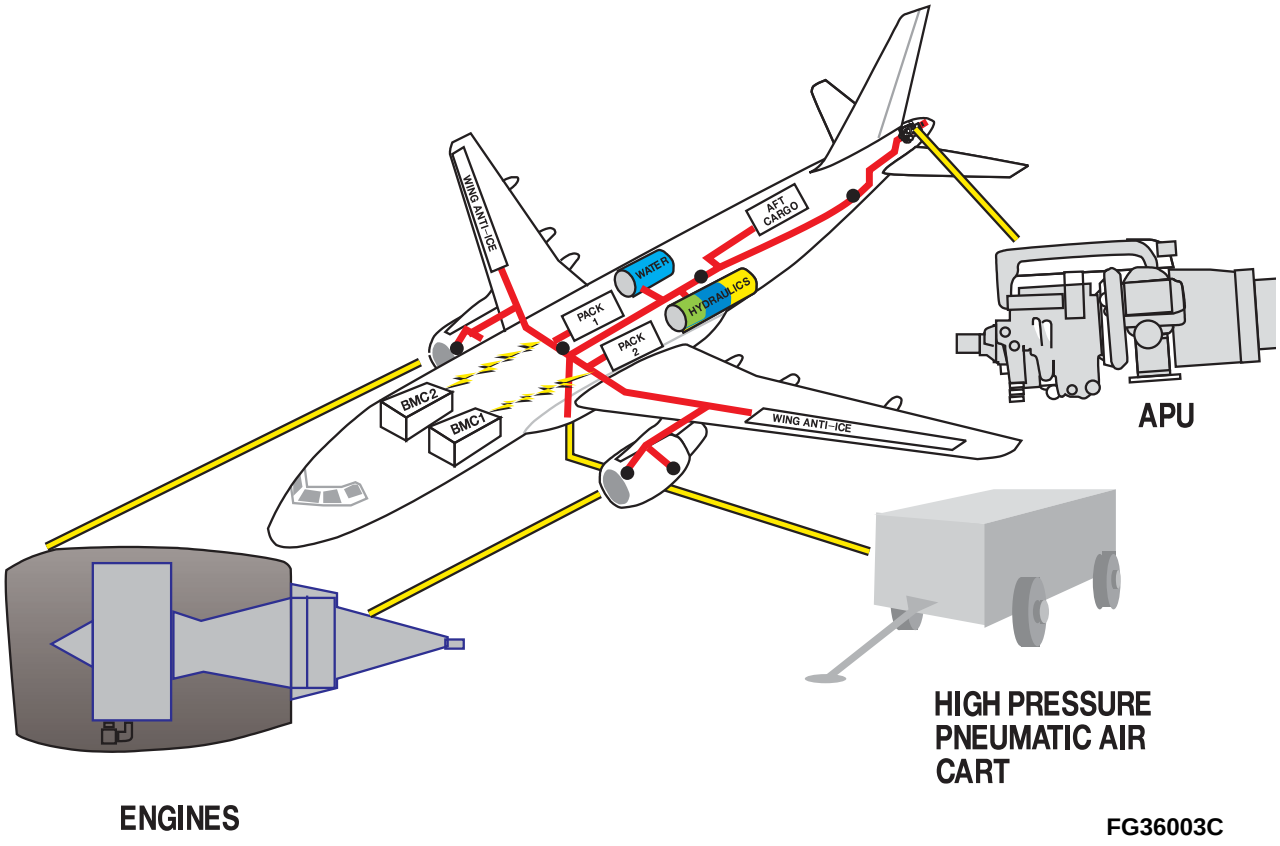
- engine 1 and 2 bleed systems,
- APU compressor bleed, or
- HP (High Pressure) ground connection.

Engine 1 and 2 bleed systems are connected by a common duct. APU and ground air sources are also connected to the duct.

System logic prevents the pneumatic duct from being pressurized by more than one source of air. However, the system is unable to detect external high pressure air connected for engine starting. Volume 1 procedures require the pilot to turn off the engine and APU bleed pbs during this procedure.

Diagram

This diagram depicts the three air sources and their location on the aircraft.



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Engine Bleed System

Description

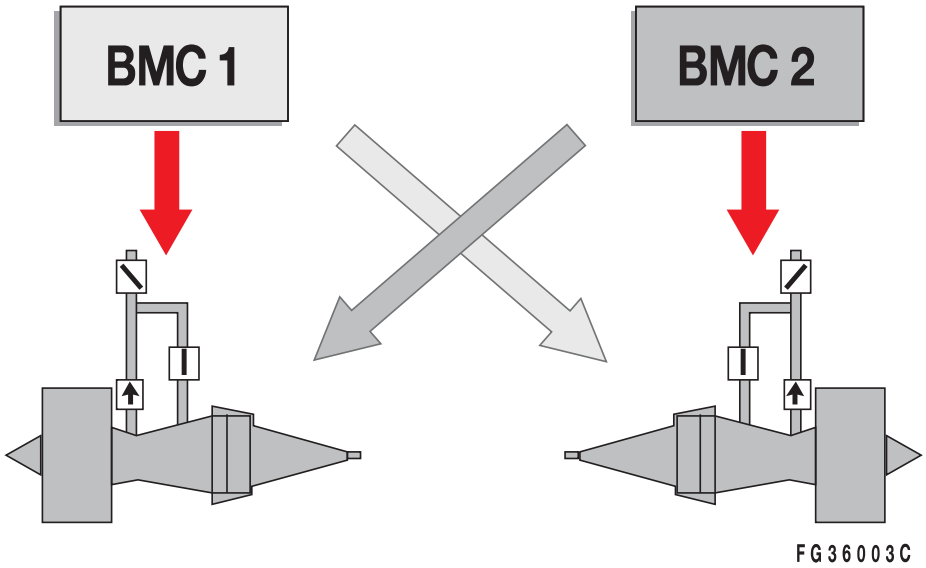
Each engine bleed system is designed to select the appropriate engine compressor stage for the existing air demand. Each system also regulates bleed air pressure and temperature.

Each system is controlled and monitored by a bleed monitoring computer (BMC 1 or 2) which receives pressure, temperature, and valve position information from the entire bleed system.

BMC 1 and 2 are interconnected. In case of a failure of one BMC, the other BMC takes over the main function to ensure operation of both bleed systems.

Diagram

This diagram is a schematic depiction of the BMCs relationship to the engine bleed system.



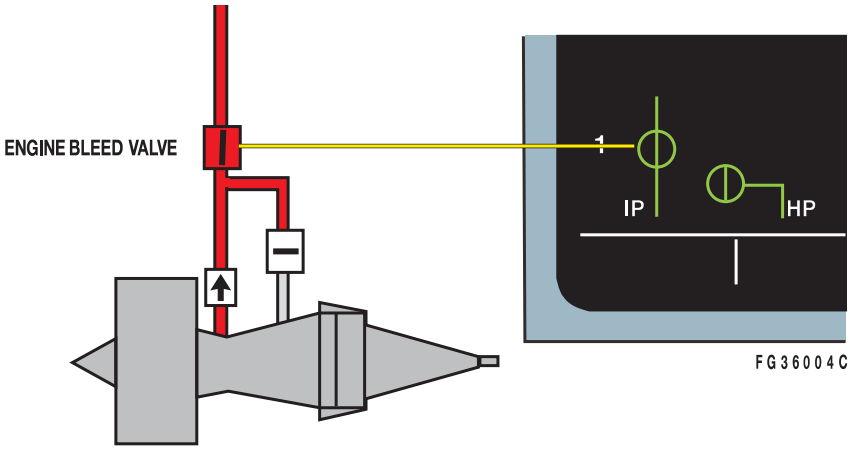
Engine Bleed System (Continued)

Air Bleed Selection and Regulation

Air is normally bled from the intermediate pressure (IP) stage of the engines' high pressure compressor. This minimizes fuel penalties.

Diagram

This diagram shows air flow during periods when IP stage air is adequate to meet demand.

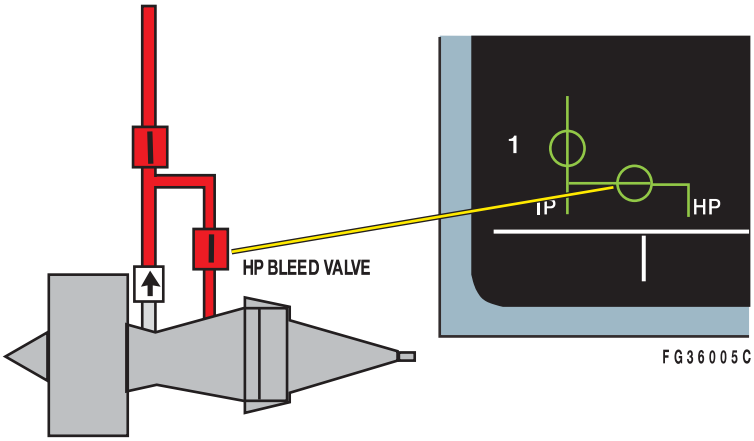


HP Air Bleed

If pressure and/or temperature from the IP stage is not adequate, air is bled from a high pressure (HP) stage of the same compressor. A check valve prevents HP air backflow into the IP stage.

Diagram

This diagram shows air flow during periods when IP stage air is **not** adequate to meet demand. This condition usually exists when the engine is running at idle.



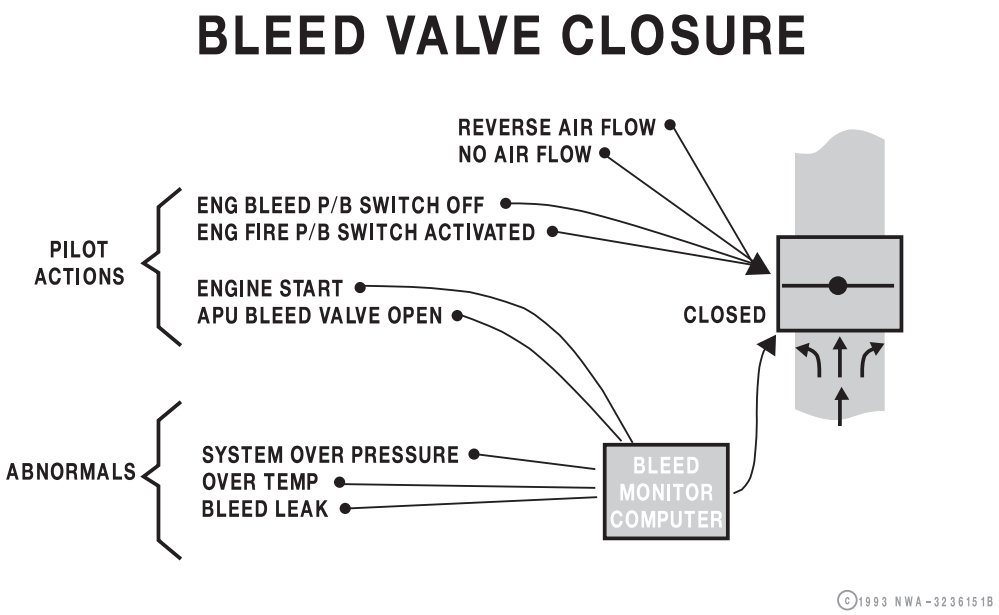
Note: IP stage and HP stage air are **never** used together.

Engine Bleed System (Continued)

Regulation

Engine bleed air pressure is regulated by the engine bleed valve, which also functions as a shutoff valve. The engine bleed valve will close:

- when the engine bleed pb is selected OFF,
- during engine start,
- when the APU bleed valve opens,
- when the ENGINE FIRE pb is selected,
- for lack of air flow (springloaded closed),
- for reverse air flow, or
- if a fault occurs:
  - if a leak is detected downstream,
  - for an overpressure detected downstream, or
  - for an overheat at the precooler.

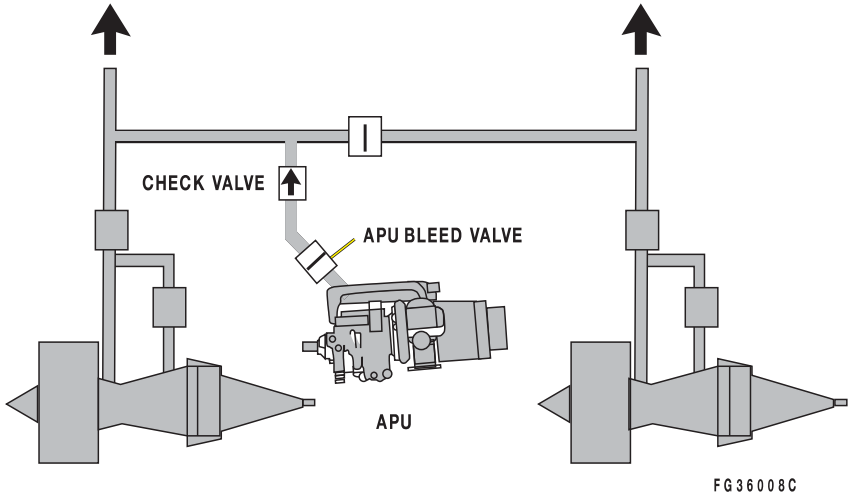


APU Bleed Air Supply

Description

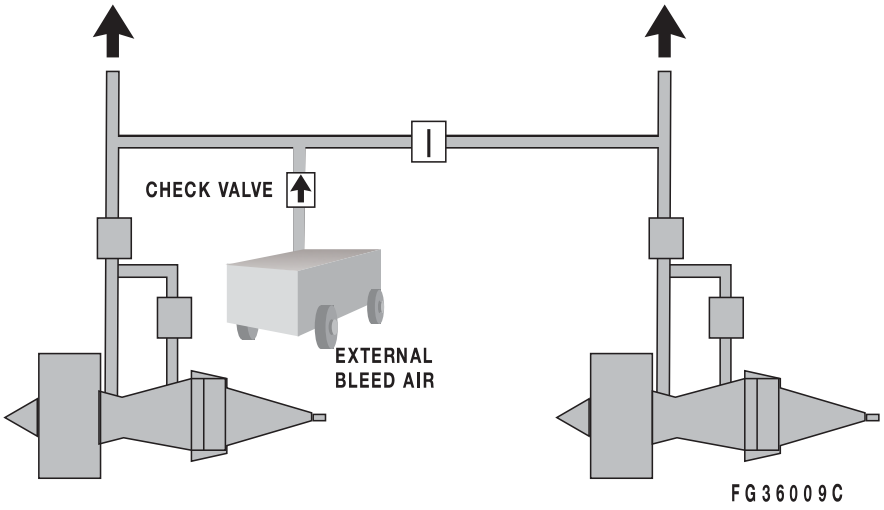
APU bleed air is controlled by the APU bleed valve which operates as a shutoff valve. This valve is controlled by the APU bleed pb on the overhead panel. The engine bleed valves close automatically when the APU bleed valve opens. This feature automatically gives APU bleed air priority over engine bleed air when APU bleed air is selected and available

Note: Although APU Bleed Air is available in flight, it is normally *not* used.



High Pressure External Air

When APU bleed air is not available for ground engine starting, an external high pressure air source can be connected to the pneumatic system. It is important not to use more than one air source at a time. The BMCs do not recognize when external air is connected and therefore will not automatically reconfigure the engine or APU bleed valves. The procedure for external air engine starting can be found in the Volume 1, Supplemental Procedures section.



Crossbleed

Description

A crossbleed valve in the duct allows the engine bleed systems to be connected or isolated. The valve is controlled by a rotary selector knob on the overhead panel.

The crossbleed valve is operated by one of two electric motors. One motor is used for the automatic mode, the other for the manual mode. In the event of an electric failure, the crossbleed valve will remain in the last commanded position.

Automatic Mode

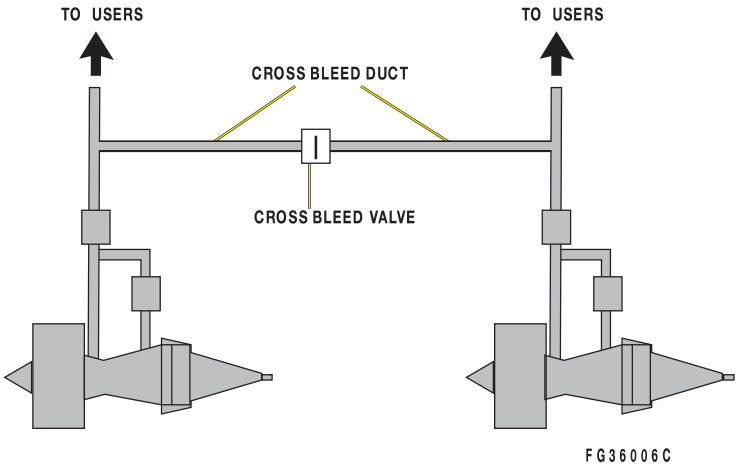
In the automatic mode, the crossbleed valve is opened and closed by the BMCs. It **opens** when APU bleed air is in use, and **closes** when APU bleed air is not in use or a leak is detected within the pneumatic system.

Manual Mode

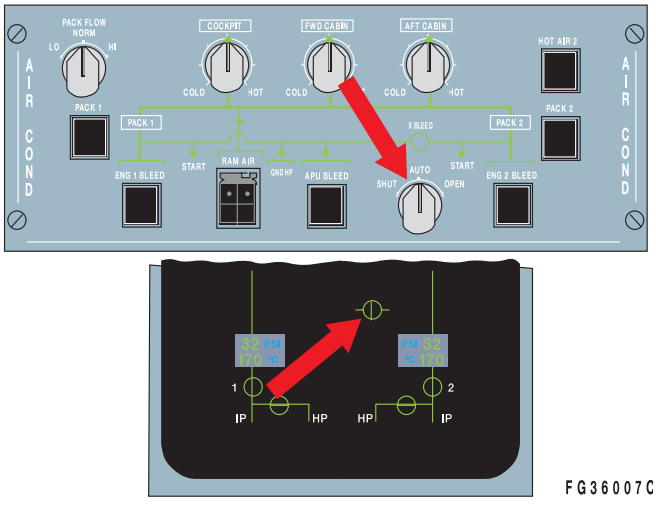
In the manual mode, control of the crossbleed valve is removed from the BMCs. A separate electric motor responds to the position of the crossbleed rotary knob on the overhead panel. When the rotary knob is placed in the OPEN position, the crossbleed valve opens and remains open under all circumstances. When the rotary knob is placed in the SHUT position, the crossbleed valve closes and remains closed under all circumstances.

Diagram

This diagram shows the relative position of the crossbleed valve, it's manual control, and ECAM depiction.



FG36006C

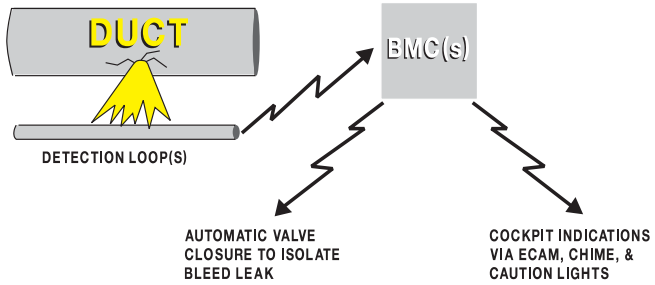


FG36007C

Leak Detection

Description

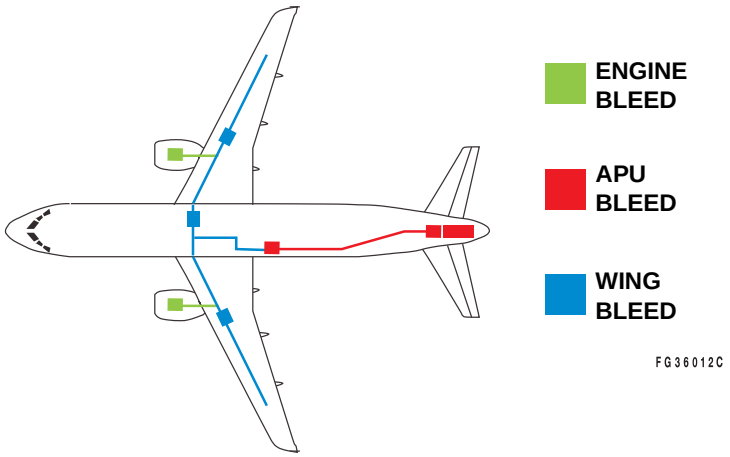
Air leak detection loops are located along all pneumatic ducts. The loops detect the high temperatures associated with a hot air leak. When a leak is detected, the BMC(s) direct the appropriate valves to close to isolate the bad duct.



Engine pylons and the APU bleed duct use a single loop. The wings use double loops.

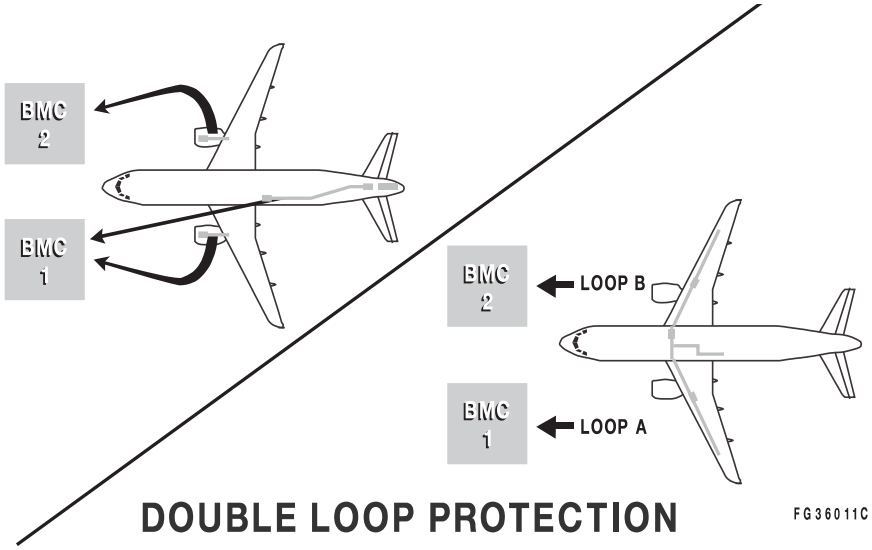
Bleed leak warnings are divided into three zones:

- Engine (which includes the pylon),
- Wing (which includes the crossfeed duct), and
- APU (which includes the APU duct).



Diagram

This diagram depicts which portions of the pneumatic system are protected by single loop and dual loop leak detection. Note that the dual loop protection provides for leak detection even if one of the BMCs should fail.



Controls and Indicators

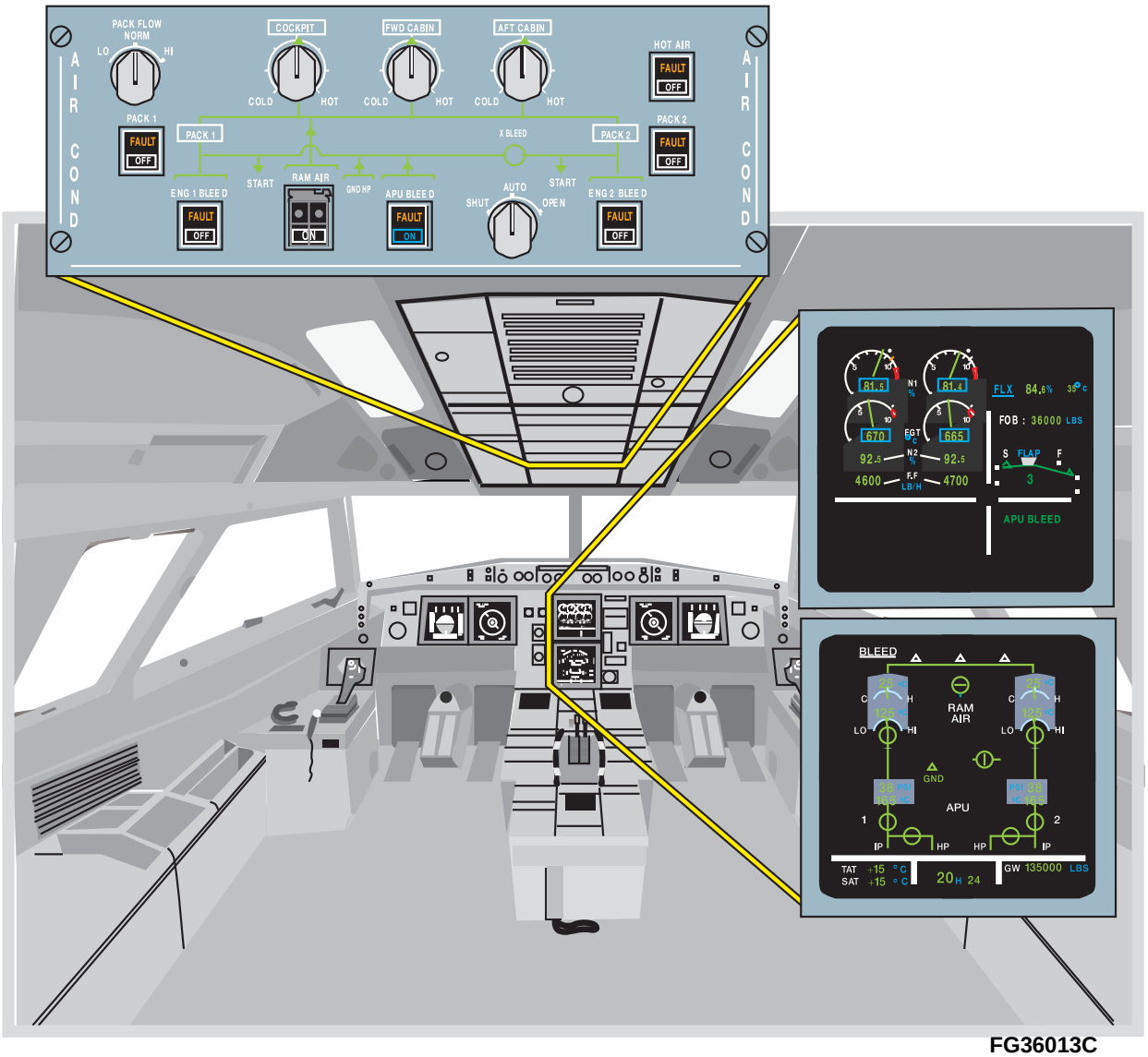
Location of Controls and Indicators

Introduction

Controls associated with the pneumatic system are located on the AIR COND overhead panel.

Location

The pneumatic system controls and indicators are located in the flight deck as shown below.

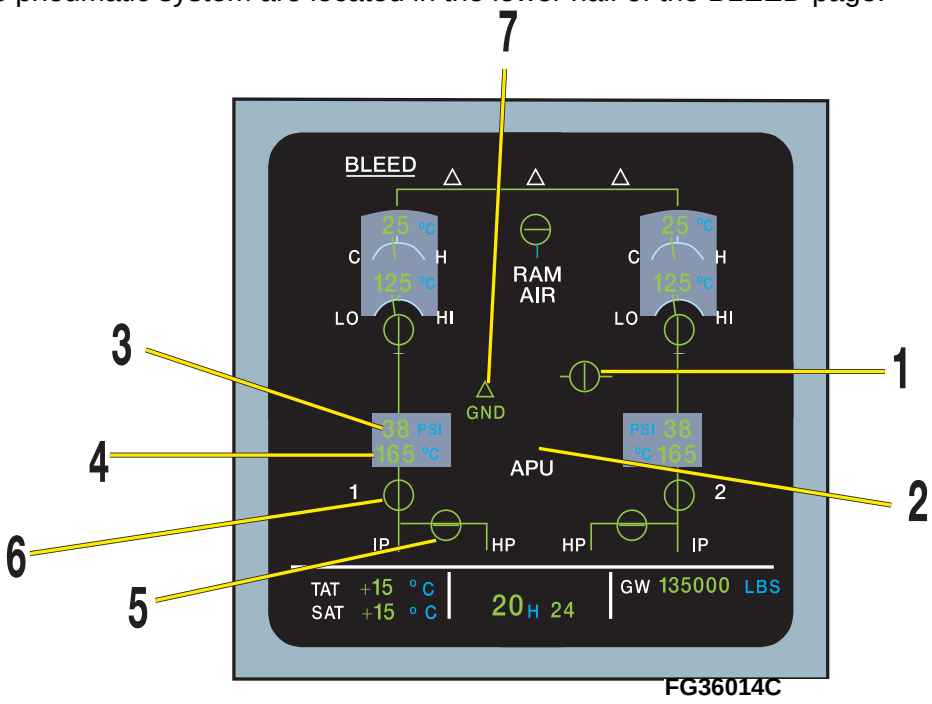


FG36013C

ECAM BLEED Page

Display

The ECAM BLEED page is viewed on the lower ECAM screen. Displays associated with the pneumatic system are located in the lower half of the BLEED page.



FG36014C

Indications

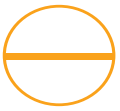
The indications included on the ECAM BLEED page are:

1. Crossbleed (X BLEED) valve
2. APU bleed valve
3. Bleed air pressure
4. Bleed air temperature
5. HP valve
6. Engine bleed valve
7. Ground indication

Each indication is described in detail on the following pages.

ECAM BLEED Page (Continued)

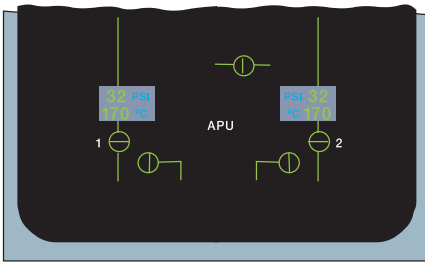
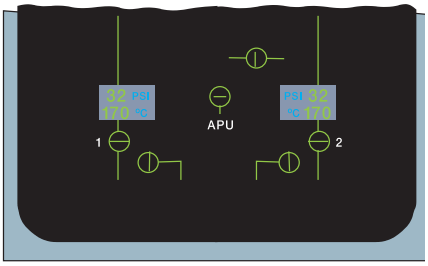
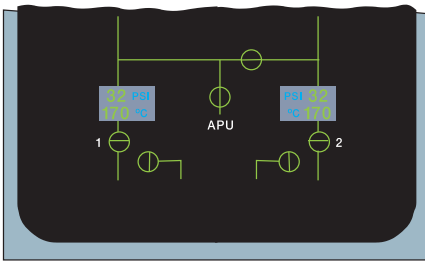
1. X Bleed Valve This display indicates the position and condition of the crossbleed valve.

Condition	Indication
A green vertical line indicates the crossbleed valve is closed.	
An amber vertical line indicates the crossbleed valve is closed when it should be open, such as when the crossbleed rotary knob is selected to OPEN, or AUTO with the APU bleed valve open.	
A green horizontal line indicates the crossbleed valve is open.	
An amber horizontal line indicates the crossbleed valve is open when it should be shut, such as when the crossbleed rotary knob is selected to SHUT, or AUTO with the APU bleed valve closed.	
An amber diagonal line indicates the crossbleed valve is in transit.	

ECAM BLEED Page (Continued)

2. APU Bleed Valve

This display indicates the position of the APU bleed valve. The valve is only displayed when the APU is available.

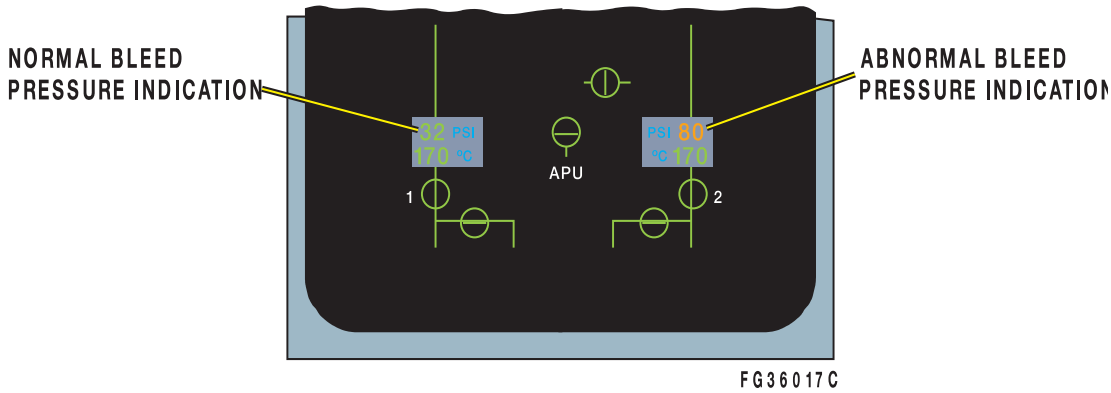
Condition	Indication	
APU in white without a valve indication means the APU is not running.	APU NOT RUNNING	
A green valve indication with a horizontal line indicates the APU is running but the bleed valve is closed.	APU RUNNING	
A green valve indication with a vertical line indicates the APU is running and the bleed valve is open, or not fully closed.	APU RUNNING & SUPPLYING BLEED AIR	

ECAM BLEED Page (Continued)

3. Bleed Air Pressure

Bleed air pressure, in psi, is displayed within a shaded box.

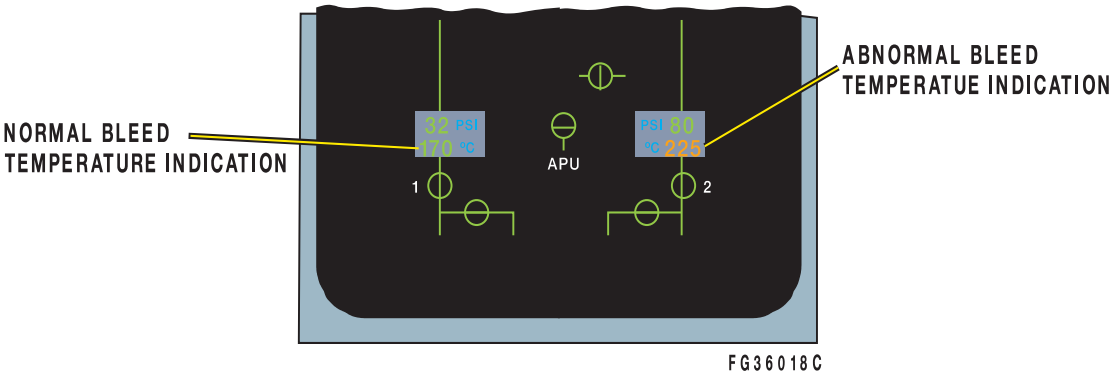
The indications are normally green. The indications change to amber and an ECAM caution is generated if a high or low pressure limit is exceeded.



4. Bleed Air Temperature

Bleed air temperature, in Celsius, is displayed within a shaded box.

The indications are normally green. The indications change to amber and an ECAM caution is generated if a temperature limit is exceeded.

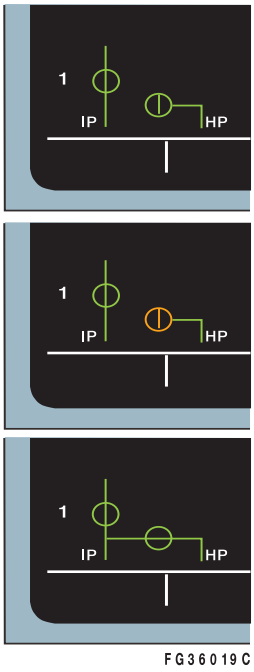


ECAM BLEED Page (Continued)

5. HP Valve

This display indicates the position of the HP bleed valve.

Condition	Indication
A green vertical line indicates the HP valve is fully closed.	
An amber vertical line indicates the HP valve is fully closed when the BMC has signaled it to open.	
A green horizontal line indicates the HP valve is open.	



FG36019C

ECAM BLEED System Display Page (Continued)

6. Engine Bleed Valve

This indicates the position of the engine bleed valve.

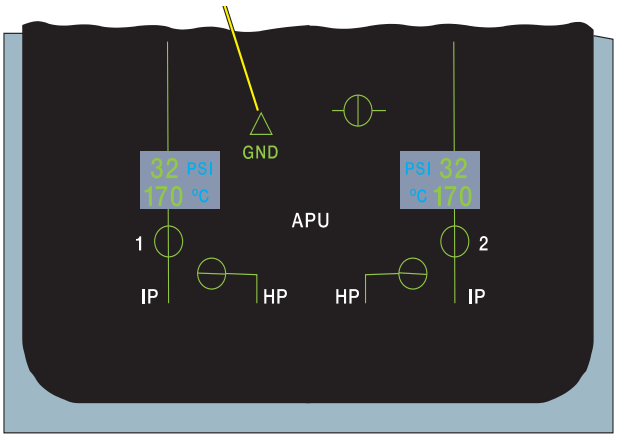
Condition	Indication
A green horizontal green line indicates the engine bleed valve is fully closed.	
An amber horizontal line indicates the engine bleed valve is fully closed, and the BMC is signaling it open.	
A green vertical line indicates the engine bleed valve is open.	
An amber vertical line indicates the engine bleed valve is open and the BMC is signaling it to close.	

ECAM BLEED Page (Continued)

7. Ground Indication

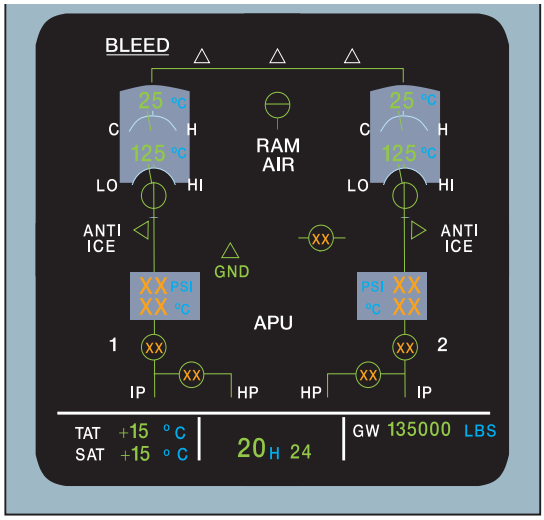
This symbol appears in green whenever the aircraft is on the ground.

Note: The ground indication does not indicate the presence or condition of ground high pressure air.



FG36021C

BMC Failure



FG36035C

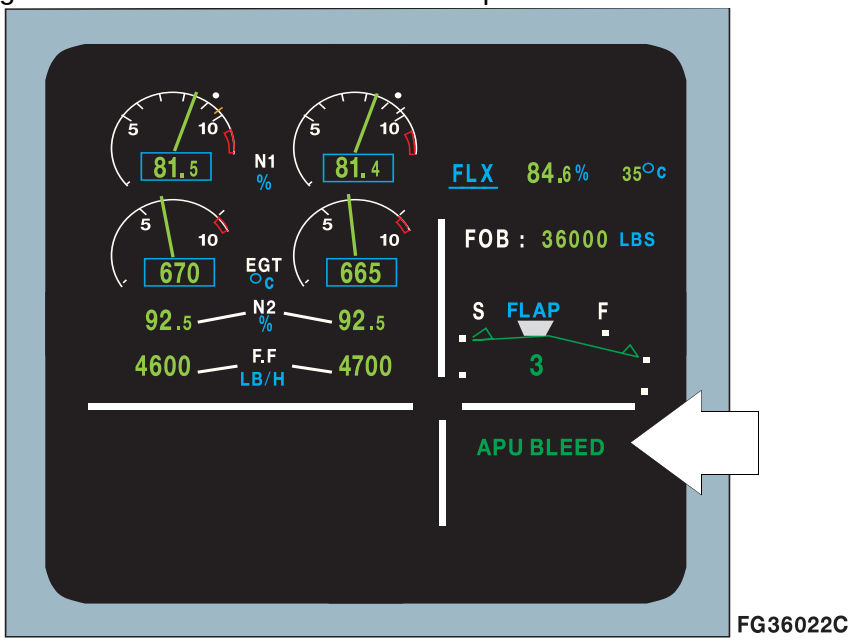
If **both** BMCs fail, all pneumatic system displays are replaced by amber Xs on the ECAM BLEED page.

Note: In this situation the pilot can no longer directly monitor the operation of the pneumatic system. The pilot can still manually open and close the engine and APU bleed valves using the pbs and the X BLEED valve using the rotary selector. Protection against excessive system temperatures and pressures is provided by mechanical backup devices. Bleed leak protection is **not** provided.

Upper ECAM Bleed Indications

APU Bleed Message

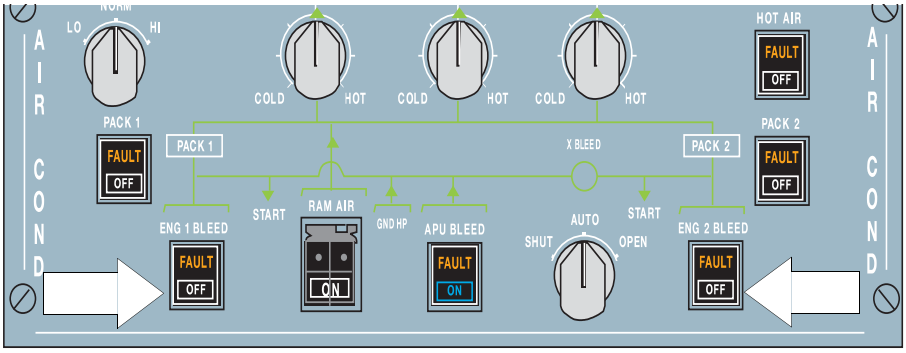
This message indicates the APU bleed valve is open.



FG36022C

ENG 1 (2) BLEED pbs

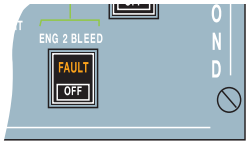
Diagram



FG21043C

Function

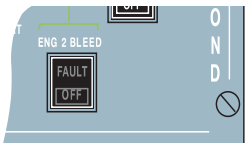
The pbs allow pilot control of the engine bleed valves.



FG36023C

On

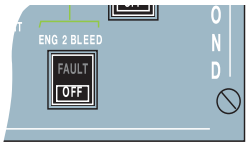
When selected on (lights out), the engine bleed valve opens when engine bleed air pressure and temperature are normal, no leaks are detected, and the APU bleed valve is closed.



FG36024C

OFF

The OFF (out) position closes the engine bleed valve. When selected off, OFF illuminates on the pb.

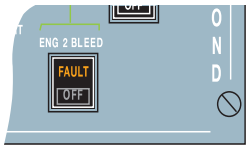


FG36025C

FAULT

FAULT illuminates when:

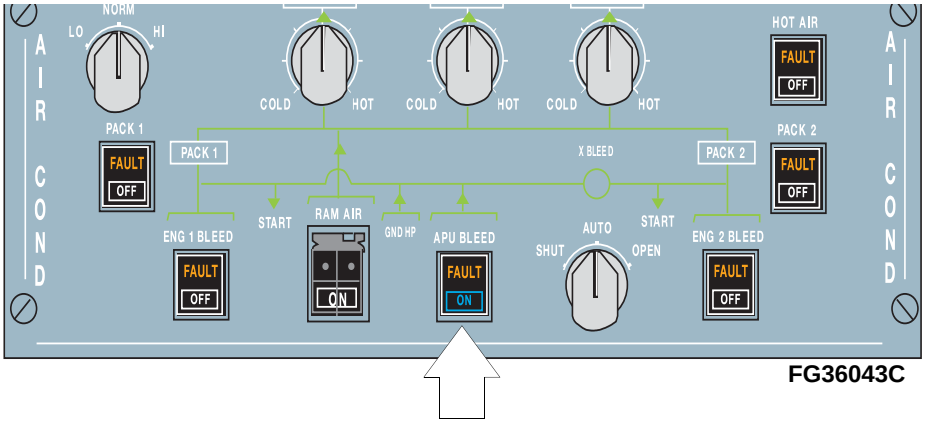
- an engine bleed temperature or pressure limit has been exceeded,
- there is a disagreement between the actual valve position and the commanded valve position, or
- a bleed air leak is detected.



FG36023C

APU BLEED pb

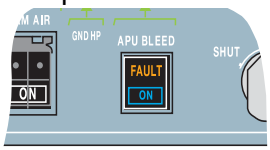
Diagram



FG36043C

Function

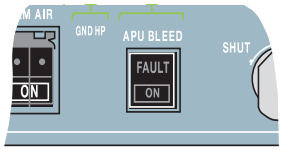
The APU BLEED pb controls the operation of the APU bleed valve.



FG36027C

Off

In the off (lights out) position, the APU bleed valve closes.



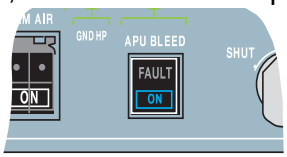
FG36028C

ON

In the ON position, the APU bleed valve opens if APU bleed air is available and no air leaks are detected.

When the APU bleed valve opens, this also causes the engine bleed valves to close, and the crossbleed valve to open, when the X BLEED selector is in AUTO.

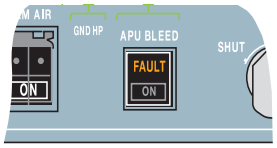
ON illuminates blue on the pb, and APU BLEED appears on the E/WD.



FG36029C

FAULT

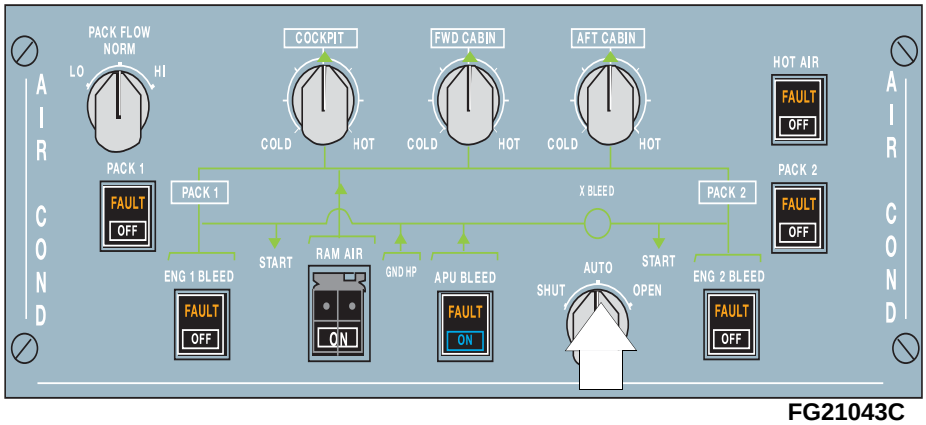
FAULT illuminates when a leak is detected in the APU bleed duct.



FG36027C

X BLEED Switch

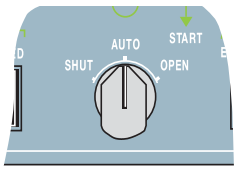
Diagram



FG21043C

Function

The X BLEED rotary switch allows for operation of the crossbleed valve.



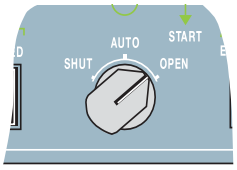
FG36031C

AUTO

In the AUTO position, the BMC opens the crossbleed valve whenever the APU bleed valve opens.

OPEN

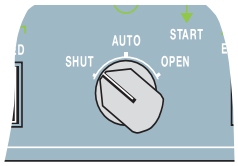
In the OPEN position, the crossbleed valve opens and remains open regardless of any fault condition, or BMC signal.



FG36032C

SHUT

In the SHUT position, the crossbleed valve closes and remains closed regardless of any BMC signal.



FG36033C

Chapter 49: APU

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System Description

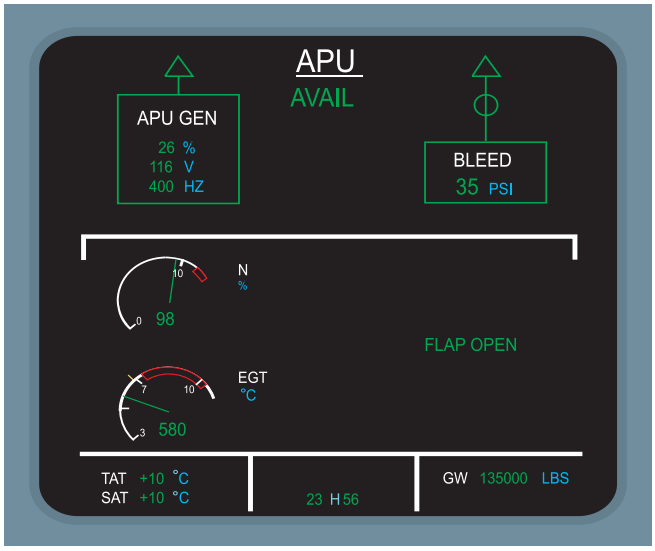
General Description

Overview

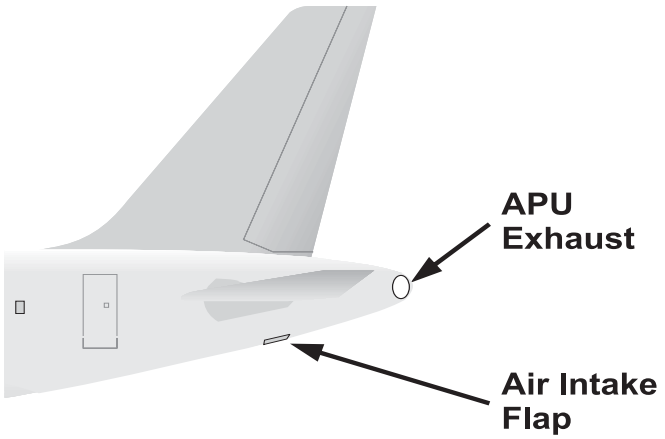
The aircraft is equipped with a single shaft gas turbine powered Auxiliary Power Unit (APU) located within a fire proof compartment at the tail section of the fuselage.

The APU is equipped with a generator which can power the entire electrical system network. In addition, the APU can provide high pressure air for engine starts and air conditioning system operation.

APU controls are located on the APU section of the overhead control panel. In addition, APU operating parameters are displayed on the ECAM APU page.



ECAM APU Page



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APU Operating Envelope

The APU is capable of operating throughout the aircraft's entire operating envelope. However, at the higher altitudes, above approximately 25,000 feet, the APU's generator begins to become less effective in its ability to support 100% of its rated output.

APU pneumatic bleed air output is limited to an altitude of 20,000 feet.

An in flight start of the APU may be attempted up to an altitude of 39,100 feet when the aircraft's electrical system is being powered by at least one Integrated Drive Generator (IDG). However, with only battery power available, an APU start should only be attempted up to an altitude of 25,000 feet.

Note: After approximately 1.5 hours of flight above 8,000 feet, an APU start cannot be assured due to cold soaking.

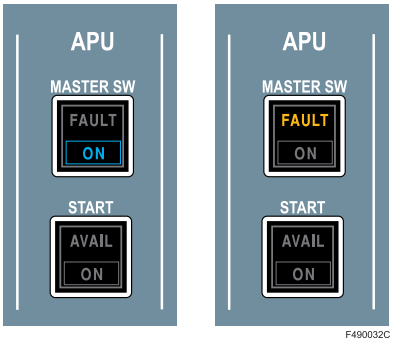
See the A320 Operating Manual Volume 1 for addition operating limitations.

APU Systems

Electronic Control

The APU is equipped with an electronic computer that monitors and controls all APU operation to include:

- start and shutdown sequencing
- speed and EGT adjustment
- bleed air output control
- fault monitoring and reporting
- automatic shutdown activation
- automatic fire protection (On the ground only)



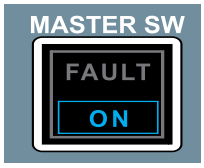
The APU's computer is enabled when the APU MASTER SW pb is selected ON. When selected, the word ON (blue) appears on the pb and, the ECAM APU page appears. In the event of an auto shut down or a failed start, the word FAULT (amber) appears on the pb. When the MASTER SW pb is selected lights out, the APU shuts down.

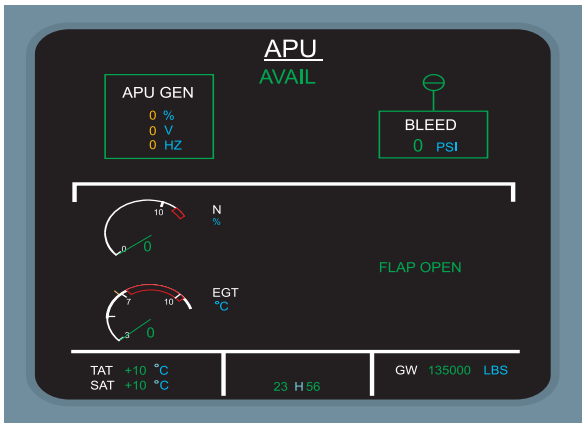
The APU MASTER SW pb is located on the APU section of the overhead panel.

Air Intake Flap

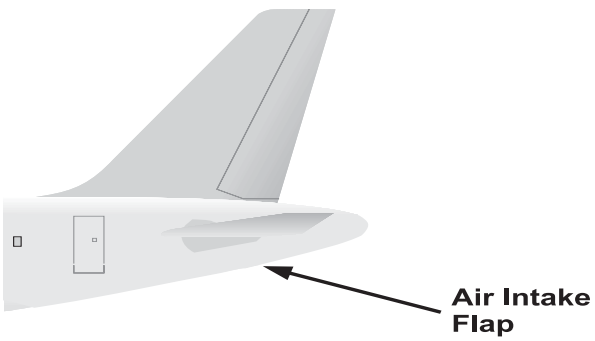
Ambient air is routed to the APU compressor through an electrically operated flap located beneath the APU compartment. The flap is commanded open when the APU MASTER SW pb is selected ON. When fully opened, FLAP OPEN appears on the ECAM APU page. The APU's computer will not permit APU start until the flap is fully open.

When the APU is shutdown, either manually or automatically, the flap is automatically sequenced closed.





ECAM APU Page



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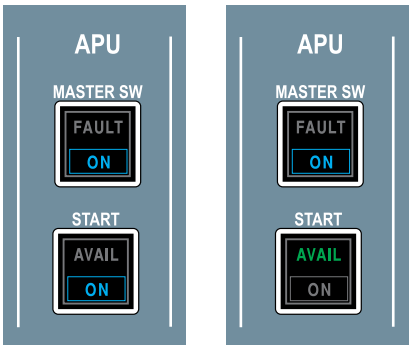
APU Systems (continued)

APU Starter Motor

An electrically powered starter motor is used for all APU starts. The starter motor is sequenced to engage by selecting the APU START pb to ON (blue). Once the start is complete, the ON indication is replaced with AVAIL (green). However, the starter will not engage until the APU flap is fully open even though the START pb is selected ON.

Note: In flight, APU start is inhibited for 45 seconds following the activation of the emergency electrical configuration.



APU Start Sequenced

APU On Speed

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The APU starter motor, as well as the APU computer, can only be powered by the DC BAT Bus. However, in order for these components to receive power from the DC BAT Bus, the aircraft batteries must be selected on (lights out). Therefore, the aircraft batteries must be selected ON for all APU starts regardless of the power source to the aircraft's electrical system.

Once the APU is running, the aircraft batteries may be selected OFF without any affect to the APU's normal operation.

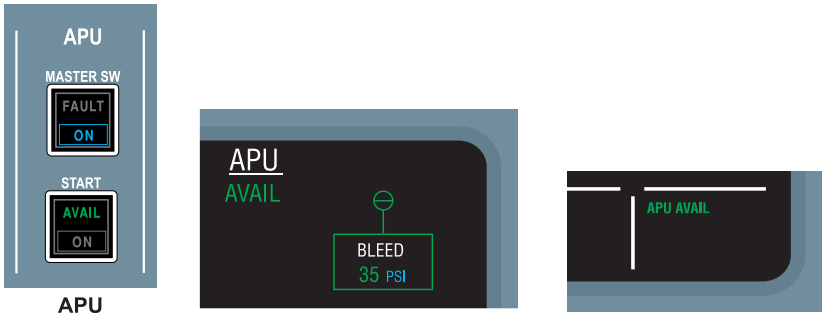
Caution: *On the ground, when the APU is the sole source of power to the aircraft, the aircraft batteries must be selected on. This will ensure a power source for extinguisher discharge in the event of an APU fire. The batteries may be selected OFF for short periods in order to accomplish preflight of the batteries.*

Available Indications

Once the APU has been started and has reached it's operational speed (on speed), the word AVAIL (green) appears at several different locations.

- on the APU START pb, AVAIL replaces the blue ON indication
- on the ECAM APU page
- on the E/WD memo section

All these AVAIL indications mean that the APU's RPM is on speed and is capable of providing bleed air or bleed air output.



APU Control Panel

ECAM APU Page

E/WD Memo Section

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APU Systems (continued)

Fuel System

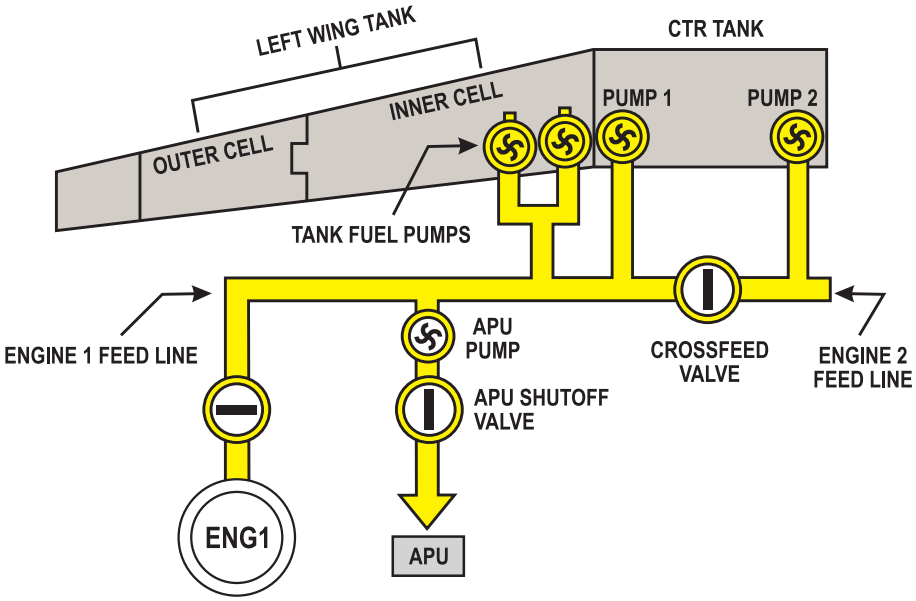
The APU fuel pump operation is completely automated and is controlled by the APU computer. The APU fuel supply line is directly connected to the Engine 1 Feed Line. Typically the left wing tank (Inner cell) supplies fuel to the APU.

When the APU MASTER SW pb is selected ON, the APU computer senses whether the Engine 1 Feed Line is pressurized, if it is not, the APU fuel pump is automatically activated.

If the Engine 1 Feed line is pressurized, the APU fuel pump is inhibited. If the APU fuel pump is running, and the engine 1 Feed line is subsequently pressurized, the APU fuel pump is commanded to stop running.

Note: With the fuel system Crossfeed Valve closed, either left wing tank pump or the number 1 center tank pump can supply the APU. The crossfeed valve must be open in order for the right wing tank pumps or the number 2 center tank pump to supply the APU.

In the event fuel pressure is not sufficient for operation, regardless of which pump/s is supplying it, the message FUEL LO PR (amber) appears on the ECAM APU page and, the APU automatically shuts down. In addition, the word FAULT (amber) appears on the APU MASTER SW pb.



ECAM APU Page

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APU Systems (continued)

Oil System

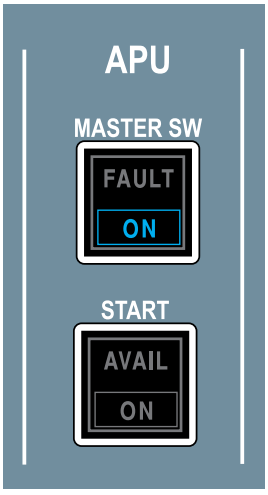
The APU has an independent oil system for lubrication and cooling. In the event the oil quantity is below a preset quantity, the message LOW OIL LEVEL (green) appears on the ECAM APU page shortly after the APU MASTER SW pb is selected ON.

Caution: *With a LOW OIL LEVEL message, the flight crew shall not attempt an APU start. Maintenance should be contacted.*

The LOW OIL LEVEL indication will not cause the APU to automatically shutdown. If the oil quantity is within limits, no message will appear.

Note: When the aircraft is on battery power, the ECAM display will not be available. Therefore, if a LOW OIL LEVEL condition is sensed, will not be displayed until normal power is established.

In the event oil pressure is below operating limits the APU will automatically shutdown. The ECAM APU page does not have a low oil pressure indication.



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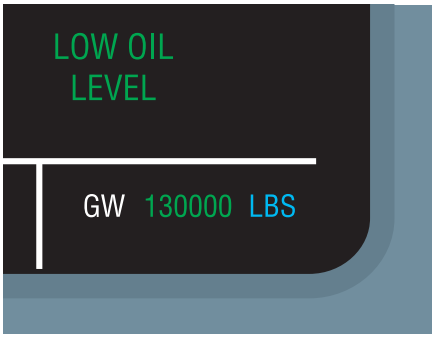


ECAM APU Page

APU Generator

The APU is equipped with a generator that is capable of powering the aircraft's entire electrical system, both in flight and on the ground.

Note: In flight, when the APU is the sole source of power, the Main Galley bus is automatically shed (partial shed).

The APU generator has the same power output rating as the IDG generators. However, it is not equipped with the constant speed drive feature found on the IDGs.

See Chapter 24 Electrical for additional information on the APU Generator.

APU Systems (continued)

Air Bleed Air System

High pressure bleed air can be extracted from the APU for:

- engine start
- air conditioning

Note: Although it is possible to use APU bleed air for wing anti-ice, its use is prohibited per Operation Manual Volume 1.

The APU's bleed air duct is directly connected to the left side of the aircraft's Pneumatic System manifold.

The APU Bleed Valve is controlled by the APU BLEED pb located on the AIR COND section of the overhead panel. When selected, the bleed valve is commanded open and, the word ON appears on the pb. Placing the pb to lights out commands the bleed valve to close.

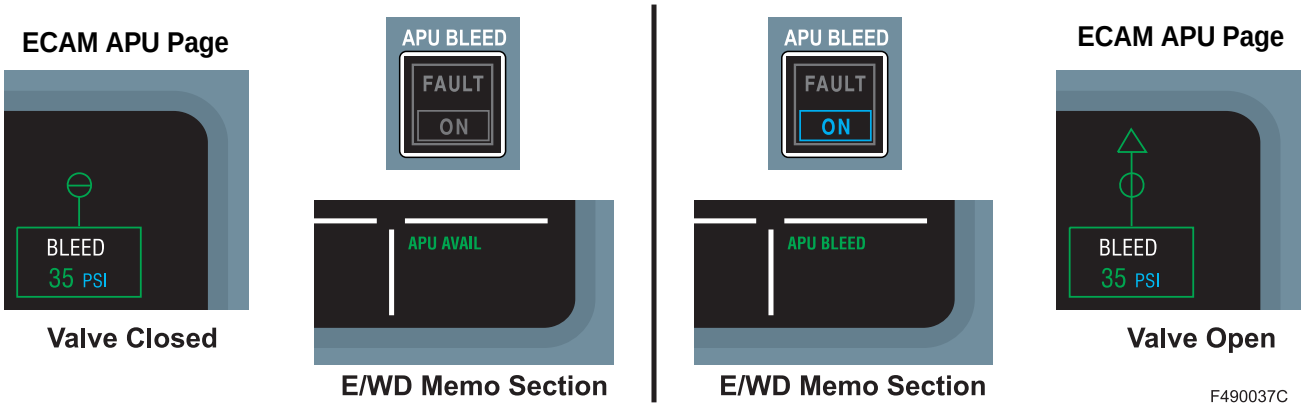
Note: The APU must be on speed (AVAIL) in order for the bleed valve to respond to an open command.

When the APU bleed valve is open and supplying the Pneumatic System manifold, the ECAM Memo section message APU AVAIL is replaced with APU BLEED.

The APU bleed air pressure value and the position of the APU bleed valve are displayed on the ECAM APU page. The pressure indication is displayed as amber XXs in the event ADIRU 2 is not available or selected OFF.

If bleed air was used during the APU's operation, upon normal shutdown, the APU will continue to run for a short cool down period (approx. 2 minutes) after the APU MASTER SW pb has been selected OFF (lights out). This cool down period is bypassed in the event of an automatic shutdown.

See Chapter 36 Pneumatics for additional APU Bleed System information.



APU Systems (continued)

Fire Detection / Protection

The APU's fire detection/protection system consists of:

- a Dual Loop sensor (detection)
- a single halon fire extinguisher (protection)

Fire detection and protection is available whenever the DC BAT bus is powered. Therefore, with only aircraft battery power, the system is operational and can be tested prior to a battery start of the APU.

Note: Testing of the fire detection system while the APU is operating will not result in an APU shutdown.

On the ground, when a fire has been detected, the APU will automatically shut down and the Halon extinguisher will be automatically discharged. In addition, an external horn located at the nose gear will sound.

Caution: *On the ground, when the APU is the sole source of power to the aircraft, the aircraft batteries must be selected ON in order to ensure a power source for extinguisher discharge in the event of an APU fire. The batteries may be selected OFF for short periods in order to accomplish preflight of the batteries.*

In flight, when an APU fire has been detected, the APU will not perform an automatic shut down. The pilot must manually shutdown the APU and discharge the Halon extinguisher.

Note: In flight, the APU will perform an automatic shutdown for operational exceedances (i.e low oil pressure, high oil temperature, overspeed etc.)

See chapter 26, Fire Protection, for additional information.

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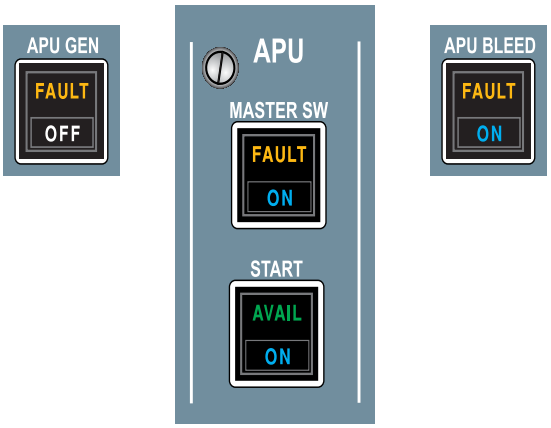
Controls and Indicators

Location of Controls and Indicators

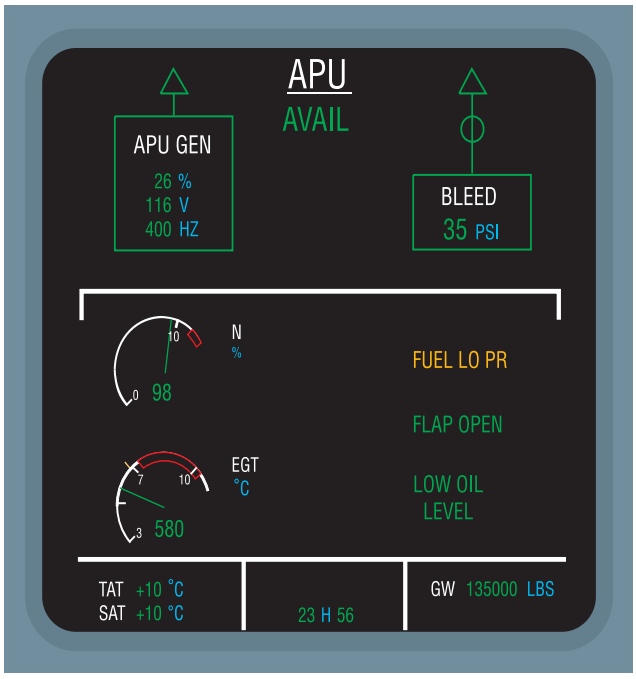
Overview

APU controls are located on the overhead panel of the flight deck. Operating parameters are displayed on the ECAM APU page and on the E/WD memo section.

Note: For training purposes, all pushbuttons (pbs) are illuminated and all ECAM APU page displays are presented.



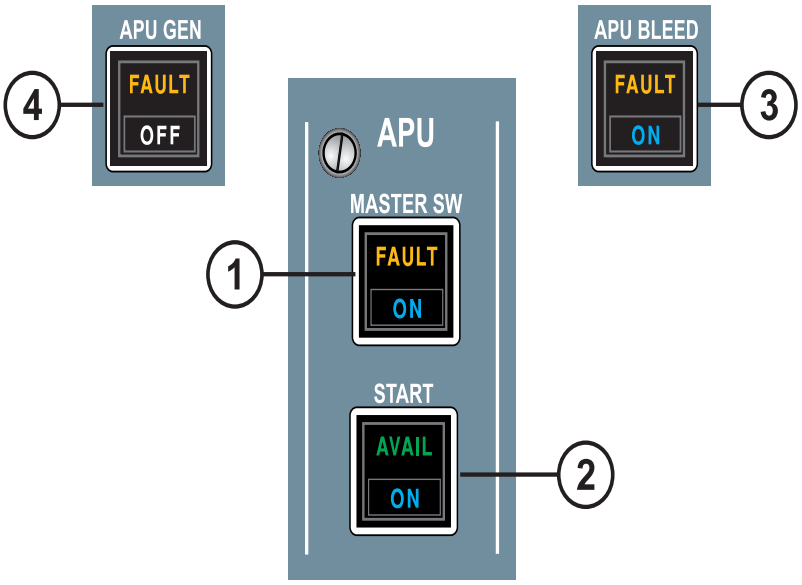
Overhead Control Panel



F490035C

ECAM APU Page

APU Control Panel



Overhead Control Panel

F490036C

1 MASTER SW pb

ON - APU computer is enabled:

- Air Intake flap is commanded open
- APU Fuel pump operates if required
- Oil quantity is sensed
- ECAM APU page appears (with normal power)

FAULT - Automatic shutdown has occurred or a failed start

2 START pb

ON - Starter motor is energized

Note: Even with an ON indication, the APU starter motor will not engage until the Intake Flap is fully open.

AVAIL - APU is on speed, start completed

3 APU BLEED pb

ON - Bleed valve is open

Lights Out - Bleed valve is closed

FAULT - Bleed valve is closed due bleed leak or valve failed in position

See Chapter 36 Pneumatics for additional information

4 APU GEN pb

Lights Out - generator is available to operate when the APU is on speed

OFF - generator is selected off

FAULT - the generator is off due to a fault

See Chapter 24 Electrical, for additional information

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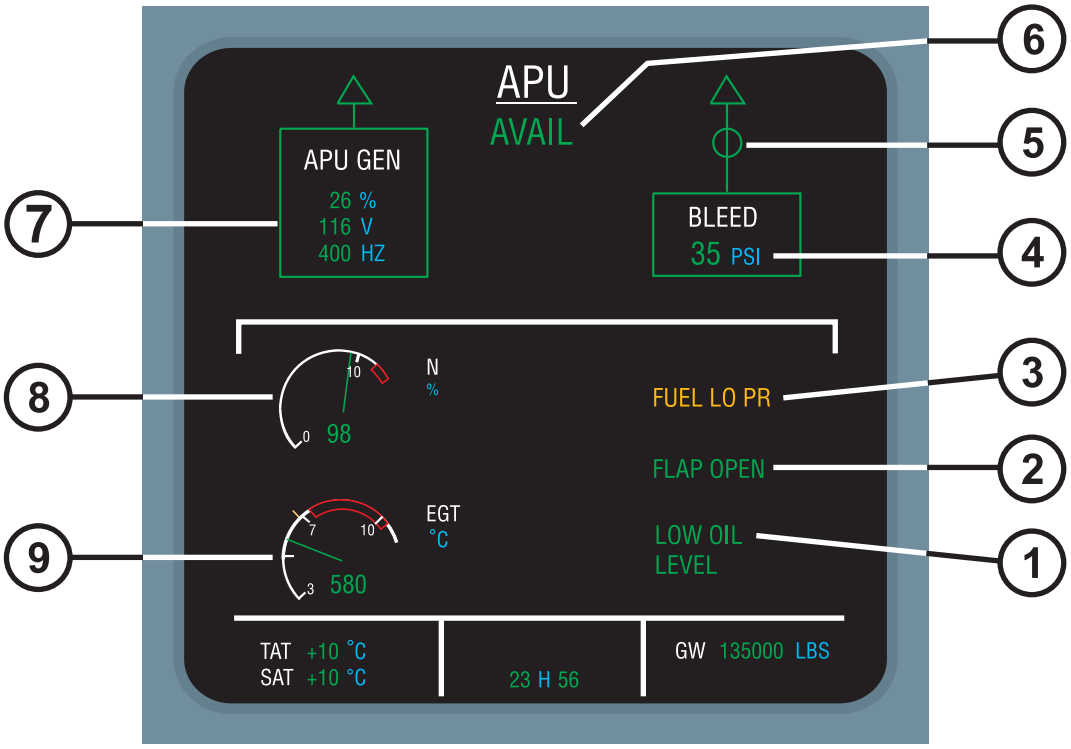
APU ECAM Page



ECAM APU Page

F490034C

E/WD Memo Section

---

(1) LOW OIL LEVEL — Indicates oil quantity is below operating requirements. APU will not automatically shutdown.

Caution: *With LOW OIL LEVEL message, the flight crew shall not attempt an APU start. Maintenance should be contacted.*

---

(2) FLAP OPEN — Air intake flap is fully open

---

(3) FUEL LO PR — Fuel pressure is below operating limits. APU will automatically shutdown

APU ECAM Page (continued)

(4) **BLEED**	Displays APU bleed air pressure output. The green arrow indicates that APU bleed air is being applied to the pneumatic system manifold. Pressure value is replaced with amber Xs if ADIRU 2 is inoperative.
(5) **Bleed Valve**	A vertical green line indicates an open valve. A horizontal green line indicates a closed valve. An amber (vertical or horizontal) line indicates a disagreement with the APU Bleed pb.
(6) **AVAIL**	The APU's RPM is on speed.
(7) **APU GEN**	Displays APU generator operating load, Volts and Frequency. The arrow is displayed when the APU generator is powering the electrical system.
(8) **N%**	Displays APU RPM. Indication turns amber when RPM is approaching a preset high limit. Indication turns red when RPM has exceeded an operational limit.
(9) **EGT C**	Displays APU Exhaust Gas Temperature. Indication turns amber when temperature is approaching a preset high limit. Turns red when temperature has exceeded an operational limit.
(10) **APU AVAIL**	APU's RPM is on speed.
(11) **APU BLEED**	APU Bleed Air valve is open. This indication replaces APU AVIAL when the APU bleed valve is open.

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Chapter 52: Doors

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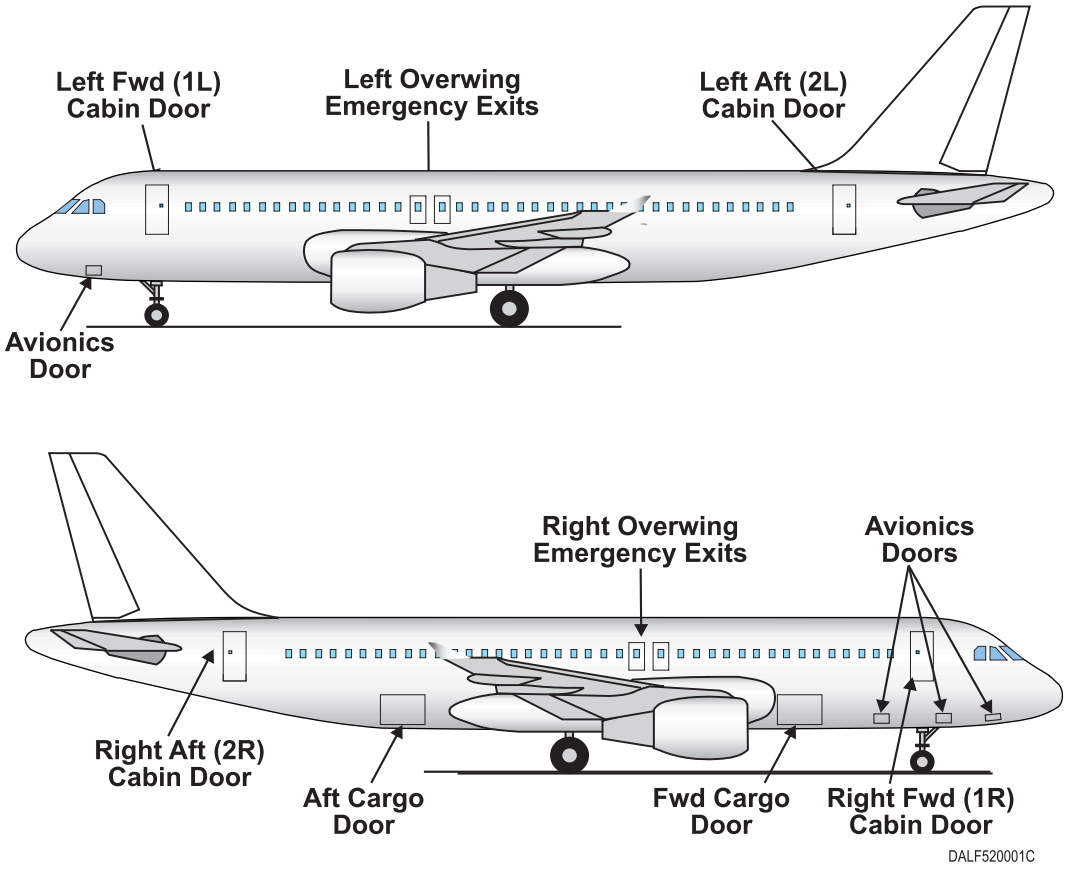
System Description

Overview

The aircraft is equipped with doors for:

- cabin entry and exit,
- emergency exit,
- cargo compartment access, and
- flight deck access.



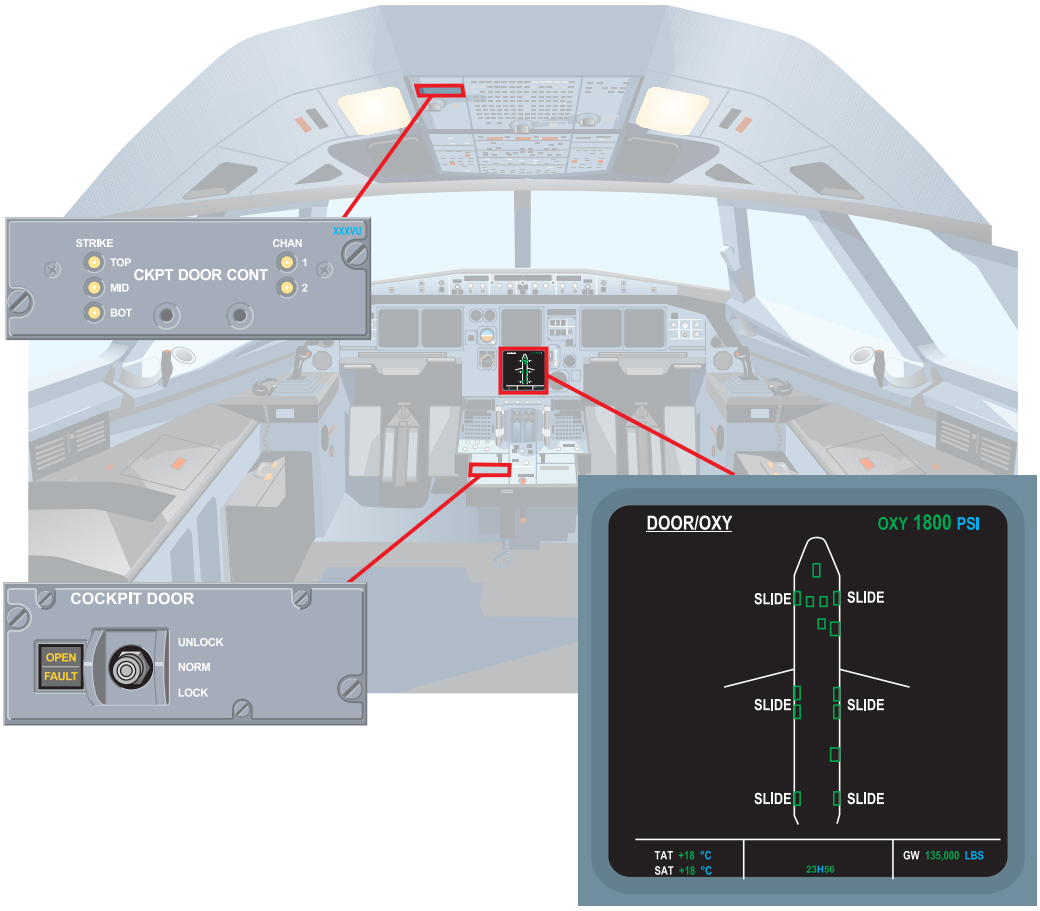
A319 Differences

There is only one overwing exit on each side.

Overview (continued)

Flight Deck Location

The flight deck locations of door controls and indicators are shown below.



F520029C

Overview

Doors are installed to permit loading and unloading of crew, passengers and cargo, emergency exiting of passengers and crew, and allow access to the avionics compartment.

System Breakdown

The doors include:

- cabin entrance doors,
- overwing emergency exits,
- cargo doors,
- external avionics compartment doors,
- internal avionics compartment door,
- flight deck door, and
- lavatory doors.

Cabin Entrance Doors

Purpose

The four cabin entrance doors are similar in design and operation. These doors may also be used as emergency escape exits.

Description

The four main cabin doors:

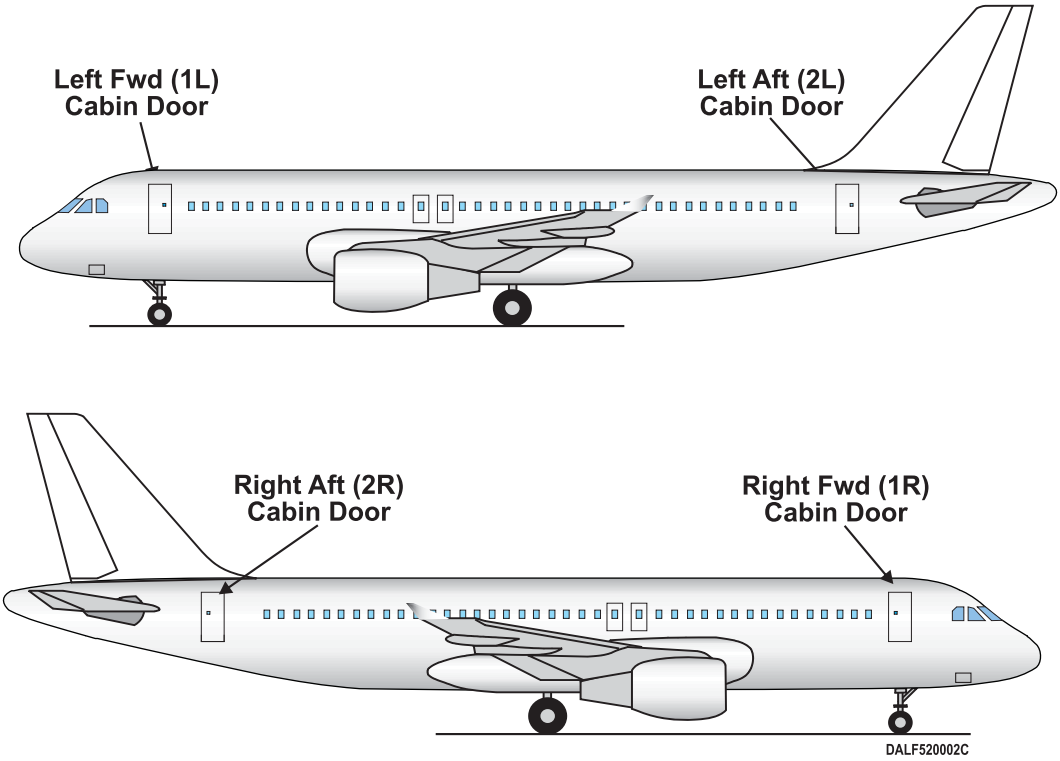
- are a plug type design,
- open outward,
- may be closed and locked from inside or outside, and
- are pneumatically assisted for emergency opening.

Some aircraft have emergency escape slide/rafts attached to the four main cabin doors.

See ch. 58, Emergency Equipment, for additional information concerning door slides and rafts.

Location

The four cabin entrance doors are shown below:



Overwing Emergency Exits

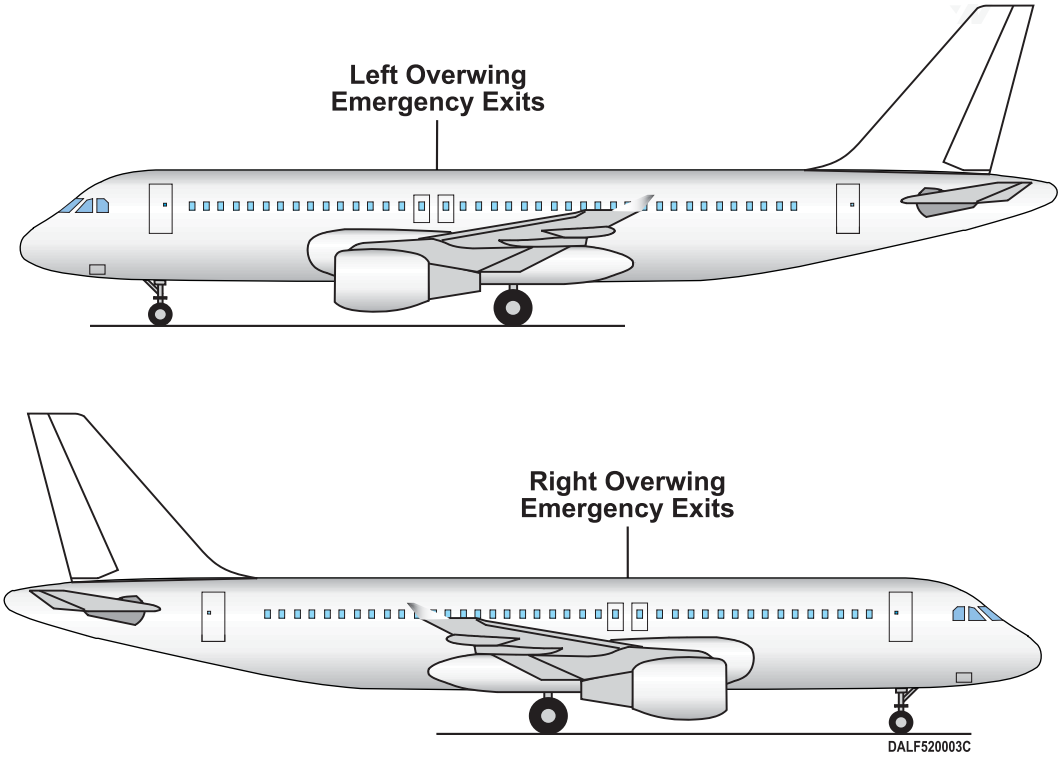
Description

There are four overwing emergency hatch exits. Each hatch:

- is a plug type door,
- contains a removable guard over the actuator handle,
- contains controls and indicators for use as an emergency exit,
- automatically deploys a dual lane escape slide when opened, and
- is monitored by the ECAM.

See ch. 58, Emergency Equipment, for additional information concerning door slides and rafts.

Location



A319 Differences

There is only one overwing exit on each side.

Cargo Doors

Description

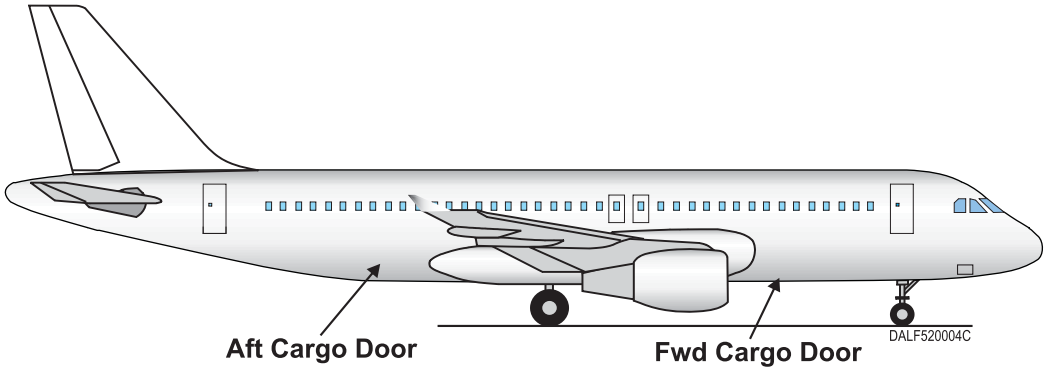
Two cargo compartment doors are located on the right side of the aircraft; one forward and one aft of the wing. Each cargo door:

- is hinged at the top,
- opens outward and upward,
- contains a locking handle and indicator,
- has a negative pressure relief vent,
- is hydraulically operated via the yellow hydraulic system electric pump or the yellow hydraulic system manual pump,
- is controlled from an external access panel, and
- is monitored and displayed by the ECAM.

Warning

Neither cargo door should be open with the right engine operating.

Location



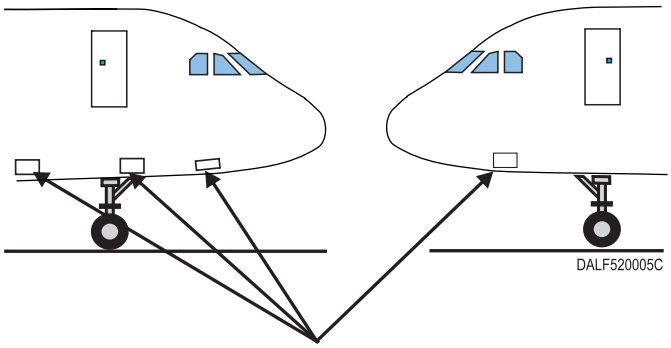
Avionics Compartment Doors

Description

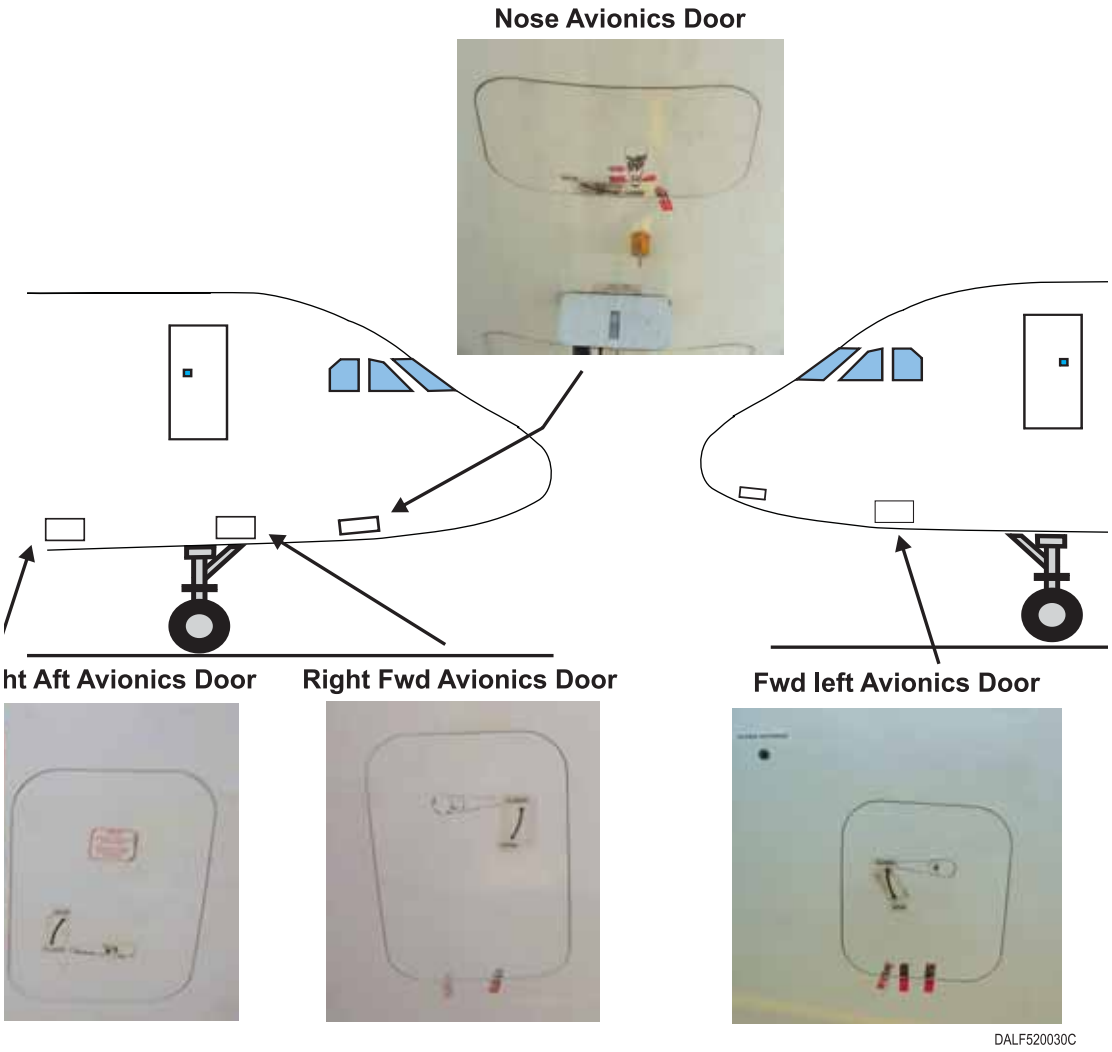
There are four external avionics access doors located on the forward exterior of the aircraft, and one internal door, flush mounted in the aisle in the forward section of the first class cabin. The four external doors:

- are a plug type,
- are hinged to open inward,
- are manually operated,
- contain a locking handle and indicator, and
- are monitored and displayed by the ECAM.

The internal door is manually operated and not monitored by ECAM.



Location


Nose Avionics Door
ht Aft Avionics Door
Right Fwd Avionics Door
Fwd left Avionics Door
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Flight Deck Door

Description

A secured, forward-opening, intrusion and penetration-resistant door separates the flight deck from the cabin. It has three electric-locking latches that can be controlled by flight or cabin crew.

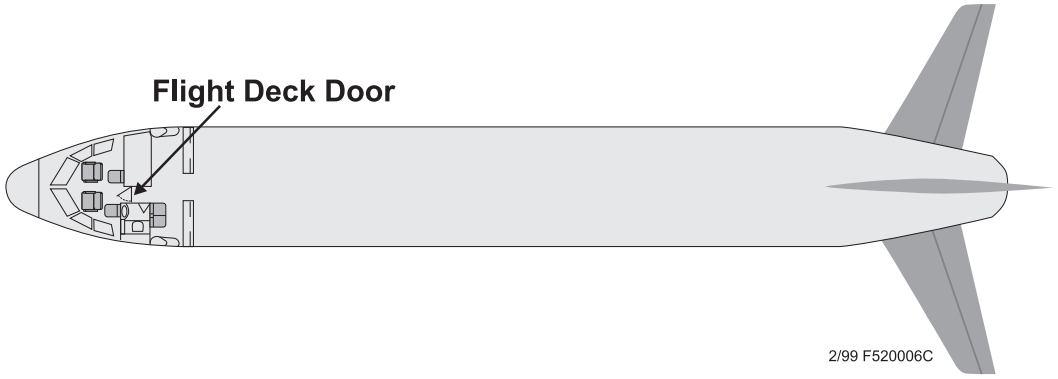
The flight crew controls the door locking mechanism using the COCKPIT DOOR toggle switch located on the pedestal. A mechanical override allows the door to be opened at any time from the flight deck.

The cabin crew can gain access to the flight deck using the keypad located outside the flight deck door.

Note: The door automatically unlocks if it is electrically unpowered or if pressure sensors detect a depressurization.

An escape panel in the door can be used to evacuate the flight deck in an emergency. The escape panel is only removable from inside the flight deck. It is removed by pulling two quick-release pins installed on each side of the panel.

Location



Lavatory Doors

Description

There is one forward and two aft lavatory doors.

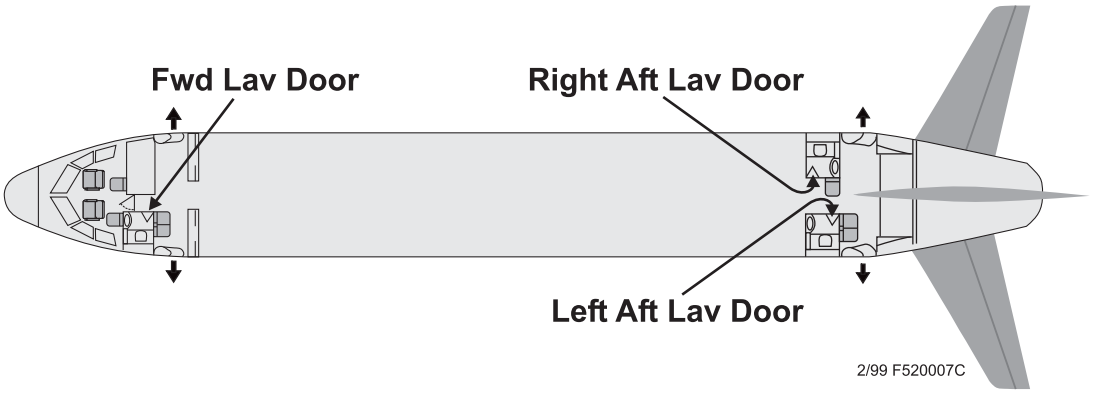
The aft lavatory doors:

- open inward,
- contain a mechanism with an indicator for locking from inside,
- have an indicator visible from the cabin,
- may be unlocked from the cabin side if necessary, and
- have removable hinges to aid in the removal of an incapacitated person.

The forward lavatory door:

- opens outward,
- contains a mechanism with an indicator for locking from the inside,
- has an indicator visible from the cabin,
- may be unlocked from the cabin side if necessary, and
- has an indicator located in the flight deck which allows pilots to monitor lavatory occupancy.

Location

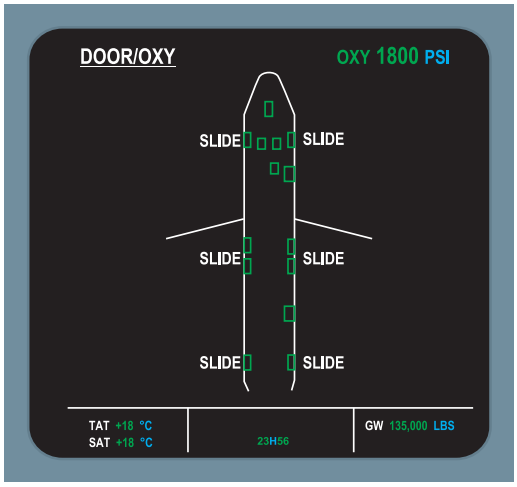


Controls and Indicators

Location of Controls and Indicators

Introduction

Controls and indicators associated with the doors on the A320 are located on or adjacent to the door being served and in the cockpit ECAM system as indicated below.



F520008C

ECAM DOOR/OXY System Display Page

Function

Normal and abnormal door/slide indications are located on the ECAM DOOR/OXY page.

The ECAM monitors:

- all external doors,
- overwing emergency exits, and
- all emergency escape slides.

Access

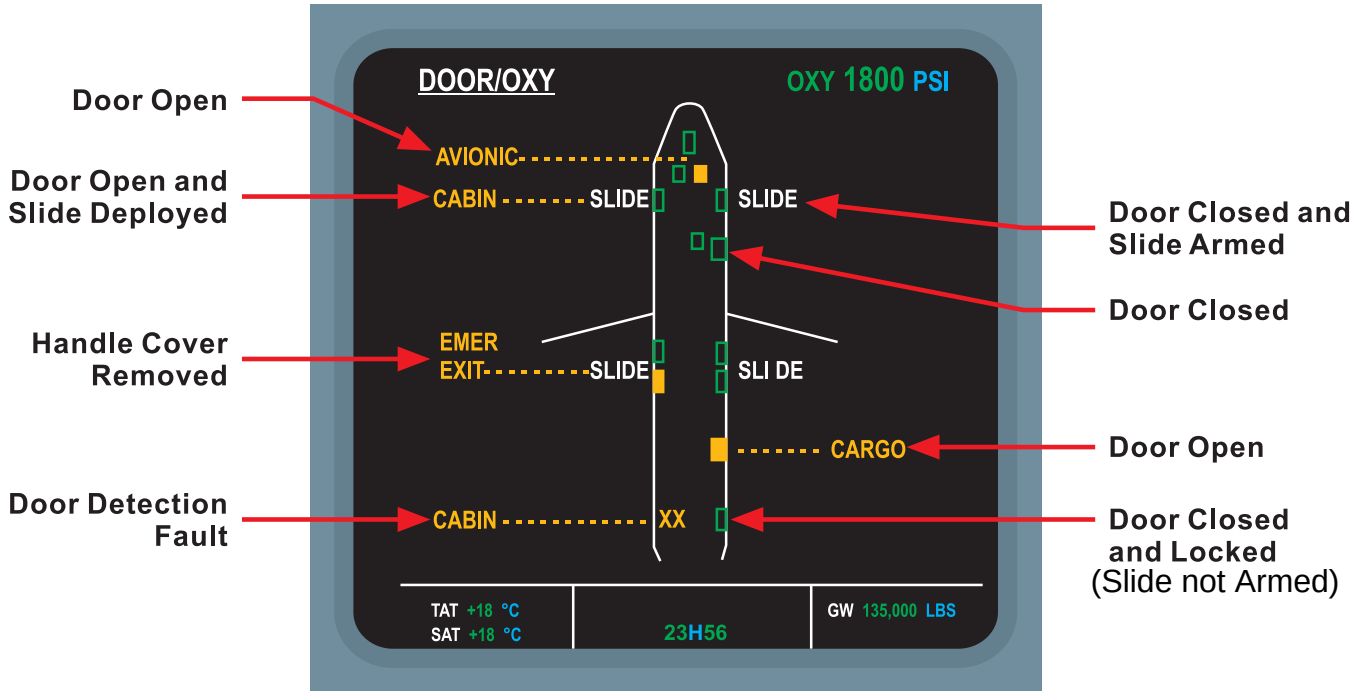
The DOOR/OXY page is accessed both automatically and manually.

It appears automatically:

- as the default ECAM system display page with the engines shut down,
- when any door is not closed and an engine is running,
- when an overwing exit or its handle cover is removed, or
- when a main cabin door has been opened via the emergency opening system.

It may be selected manually by depressing the DOOR pb on the ECAM control panel.

DOOR Page

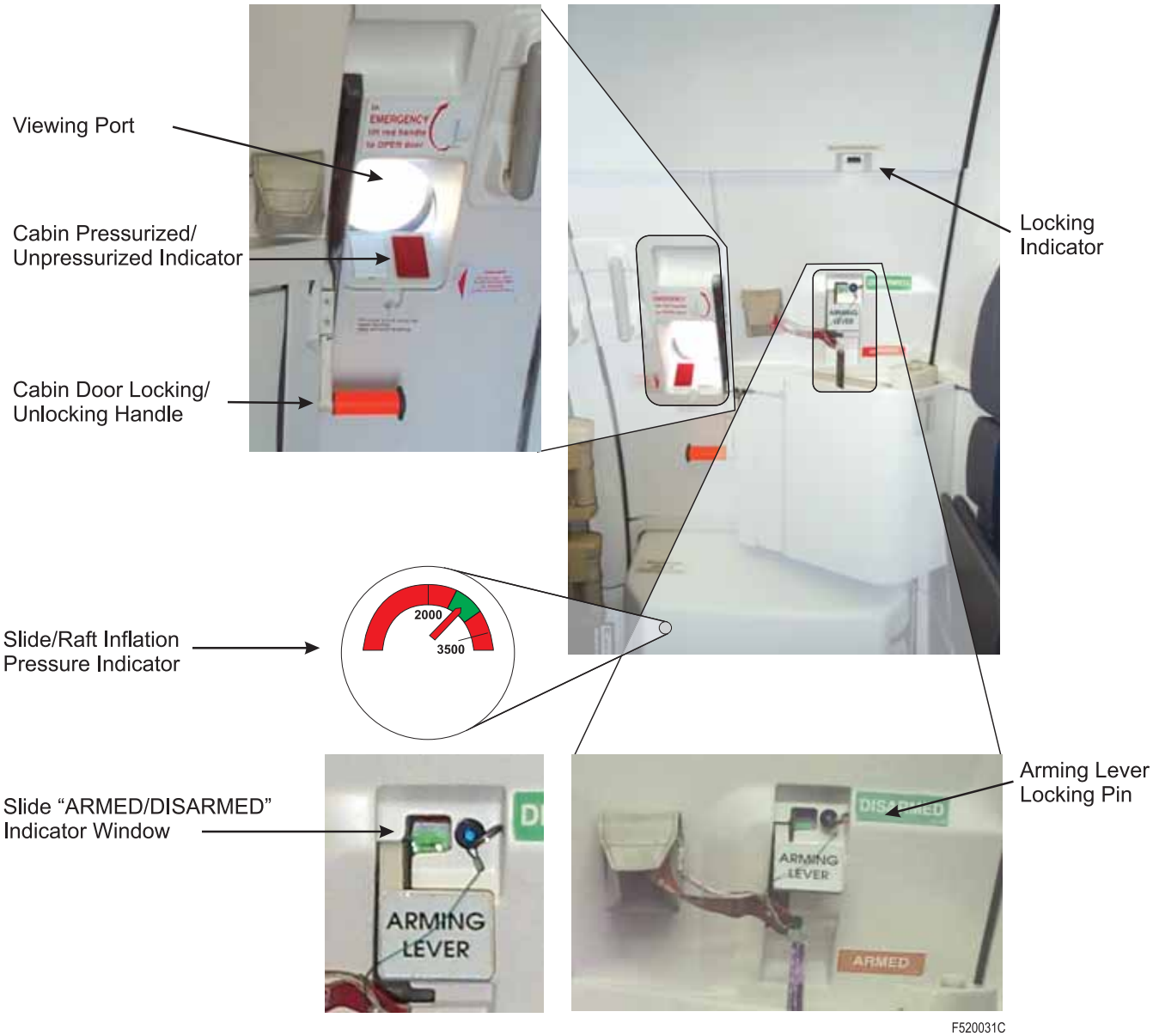


F520027C

Cabin Doors - Internal Controls

Controls

The internal controls of the doors are used to open or close the door and arm the slide/raft for automatic deployment.



Main Cabin Doors - Internal Controls (continued)

Normal Operation (DISARMED)

To open:

1. Ensure the door is disarmed.
   - DISARMED must be displayed in the ARMED/DISARMED indicator window,
   - the arming lever must be extended, and
   - the locking pin must be installed.
2. Grasp the assist handle with one hand and lift the door handle with the other.
3. Push the door outward and forward until it locks in the open position.

To close:

1. Press down on the gust lock.
2. Using the interior handle and the door assist handle, pull the door inward and aft.
3. Lower the door handle and check the locking indicator. LOCKED should be displayed.

Emergency Operation (ARMED)

1. Ensure the door is armed:
   - the locking pin must be removed,
   - the arming lever must be down and flush with the door, and
   - ARMED must be displayed in the arming indicator window.
2. Grasp the frame assist handle with one hand and lift the door control handle with the other. The door will be pneumatically assisted to the open position, automatically deploying the slide/raft.

> **Warning**
>
> **Do not hold onto the door assist handle while lifting the door control handle; this could force you out of the aircraft before the slide is inflated.**

Note: If the door pneumatic assist feature fails, the door may still be opened manually.

Note: Opening the door from the outside automatically disarms an armed door.

Note: If the slide does not deploy automatically, pull the manual inflation handle. This triangular shaped cloth handle will be visible on top of the girt bar after emergency operation of the door.

Cabin Pressurized (Red) Indicator Light

The Cabin Pressurized (red) indicator light mounted in the viewing port indicates whether the aircraft cabin is pressurized before opening the door. The red light should not be illuminated when the door is opened. The indicator can be seen from both inside and outside the cabin.

Note: The indicator light will illuminate if the cabin is pressurized with both engines shut down and the door in the disarmed position.

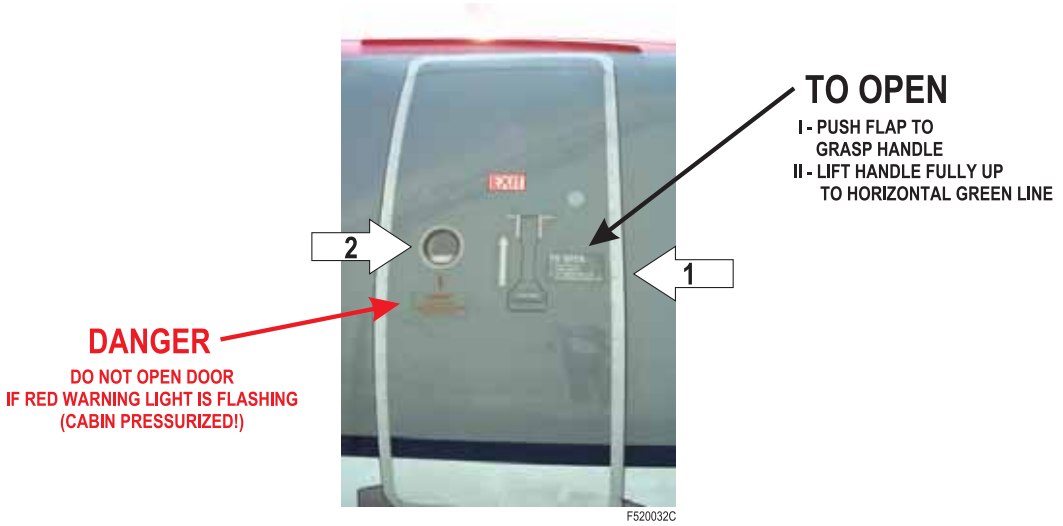
Slide Armed (White) Indicator Light

The slide armed (white) indicator light indicates an impending slide inflation. This indicator can be seen from both inside and outside the cabin.

Main Cabin Doors - External Controls

Function

On the exterior of the door is a single handle used to open and close the door.



Instructions

Instructions for door operation are located adjacent to the handle.

Note: If the door is opened from outside, the escape slide is automatically disarmed.

View Window

A window is provided for viewing whether the slide is armed and for inspecting the cabin pressure indicators.

Warning

Opening the door while the cabin is pressurized will result in sudden door opening with possible injury to the operator.

Overwing Emergency Exits

Controls

Controls and instructions for opening the overwing emergency exits are located on the doors. When the handle cover is removed, the ECAM advisory is triggered. If the cover is accidently removed, replacing it will extinguish the EMER EXIT ECAM advisory.

Operation

To open an overwing emergency exit:

- remove the handle cover,
- pull the handle down (the exit may jam if the handle is forced inward), and
- lift the exit and set it inside the aircraft.

Escape slide deployment is automatic. If the escape slide fails to automatically deploy, pull the manual inflation handle which is located in the upper corner of the opening.

Cargo Doors

Controls and Instructions

Controls and instructions for operating the cargo doors are located on the external access panel and next to the door.

HYDRAULICALLY OPERATED CARGO COMPARTMENT DOOR

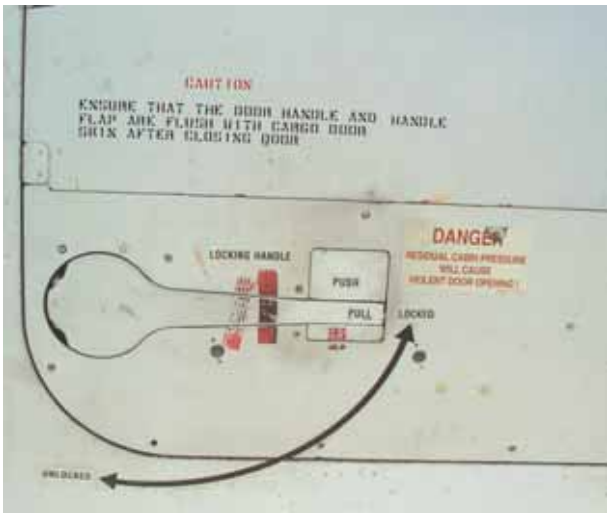
TO OPEN

1. UNLOCK DOOR BY PULLING HANDLE ON DOOR FULLY OUT AND PULL DOWNWARDS FROM "LOCKED" TO "UNLOCKED" POSITION.
2. MOVE MANUAL SELECTOR VALVE LEVER TO "OPEN" AND HOLD UNTIL DOOR IS OPEN AND GREEN INDICATOR LIGHT COMES ON.

TO CLOSE

IMPORTANT: CHECK THAT AREA BELOW DOOR IS FREE FROM OBSTRUCTION

1. MOVE MANUAL SELECTOR VALVE LEVER TO "CLOSED" AND HOLD UNTIL DOOR IS FULLY CLOSED. ENSURE THAT GREEN INDICATION LIGHT GOES OUT.
2. WHEN DOOR IS FULLY CLOSED MOVE LOCKING HANDLE ON DOOR FROM "UNLOCKED" TO "LOCKED" POSITION. IMMEDIATELY PUSH LEVER FULLY INTO RECESS TO LOCK DOOR.
3. CHECK THAT VENT FLAP ON DOOR IS FULLY CLOSED AND LOCKING HANDLE IS FLUSH WITH DOOR PROFILE.



F520034C

CARGO DOOR SELECTOR

(Located on the bottom of the fuselage aligned with the cargo door.)

F520035C

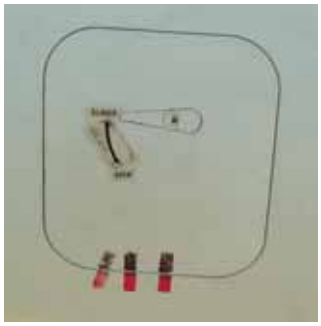
Avionics Doors

Controls

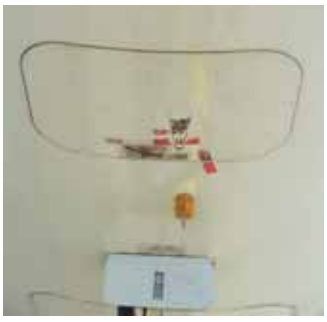
Fwd Right

Aft Right

Fwd Left



Nose Door



F520036C

Locking Handle

Each avionics door has an external locking handle. The locking handle protrudes from the door if it is in the unlocked position.

Flight Deck Door

General

A secured, forward opening, intrusion and penetration-resistant door separates the flight deck from the cabin. It has three electric-locking latches that can be controlled by the flight crew.

The flight crew controls the door locking mechanism using the COCKPIT DOOR toggle switch located on the pedestal. A mechanical override allows the door to be opened at any time from the flight deck using a recessed D-handle.

The cabin crew can gain access to the flight deck using the keypad located outside the flight deck door. The door automatically unlocks if it is electrically depowered or if pressure sensors detect depressurization.

An escape panel in the door can be used to evacuate the flight deck in an emergency. The escape panel is only removable from inside the fight deck. It is removed by pulling two quick-release pins installed on each side of the panel.

Components

Components of the flight deck door are shown below.

Keypad

Flight Deck Door

Cockpit Door Control Indicator

Cockpit Door Lock/Unlock Switch

F520037C

Flight Deck Door (Continued)

Normal Operations

During the normal mode of operation, the COCKPIT DOOR switch is in the NORM position and the door is closed with the locking solenoid energized. On the KEYPAD both the red and green lights are out.

To open the door, move and hold the COCKPIT DOOR selector switch to the UNLOCK position. This action unlocks the door and the green light on the KEYPAD illuminates steady. The green light signals the crewmember that the flight deck door is unlocked and they may push the door open.Once the COCKPIT DOOR selector switch is released, it returns to the NORM position actuating the door locks. The amber OPEN light adjacent to the selector switch will be illuminated until the door is actually locked.

F520038C

Note: The door can be manually opened from the flight deck at any time by rotating a conventional “D-shaped” recessed rotating handle.

Emergency Operations

In an emergency, the cabin crew can open the flight deck door by entering the emergency access code. If the emergency access code is entered, all of the following will occur:

- a buzzer sounds continuously on the flight deck for 45 seconds,
- the OPEN light flashes,
- the green light on the key pad flashes, then
- after 45 seconds, the door unlocks for 5 seconds and the green light on the keypad illuminates steadily.

After 5 seconds, the locking solenoid will re-engage, the buzzer is silenced, and all the lights extinguish.

Note: The LOCK mode can be initiated at any time even if the emergency access code has been entered. Momentarily moving the COCKPIT DOOR selector switch to the LOCK position, the LOCK mode is activated for a period of fifteen minutes. During this fifteen minute period, the door is locked and all normal means of door operation from the cabin are inhibited. The red light on the KEYPAD illuminates steady, the buzzer will sound, and all KEYPAD entries are ignored. Once the LOCK mode times out, the system reverts back to the NORM mode of operation. The NORM mode can be re-energized at any time by momentarily selecting UNLOCK on the COCKPIT DOOR panel.

Warning

If a continuous buzzer is heard, the emergency access code has been entered. Unless you desire emergency assistance on the flight deck, either pilot should immediately move the COCKPIT DOOR selector switch to the LOCK position and attempt contact with the lead flight attendant to ascertain the situation.

Flight Deck Door (continued)

Emergency Operations (continued)

If the pressure sensors detect a differential pressure caused by a rapid depressurization in the flight deck, or if electrical power is lost, the electronic controller will instantly unlock the door allowing the flight deck door to swing free.

CKPT DOOR CONT Panel

The two flight deck door pressure sensors are located on the CKPT DOOR CONT panel on the overhead panel. Lights installed on the CKPT DOOR CONT panel indicate the status of the pressure sensors and each of the three door latches.

F520039C

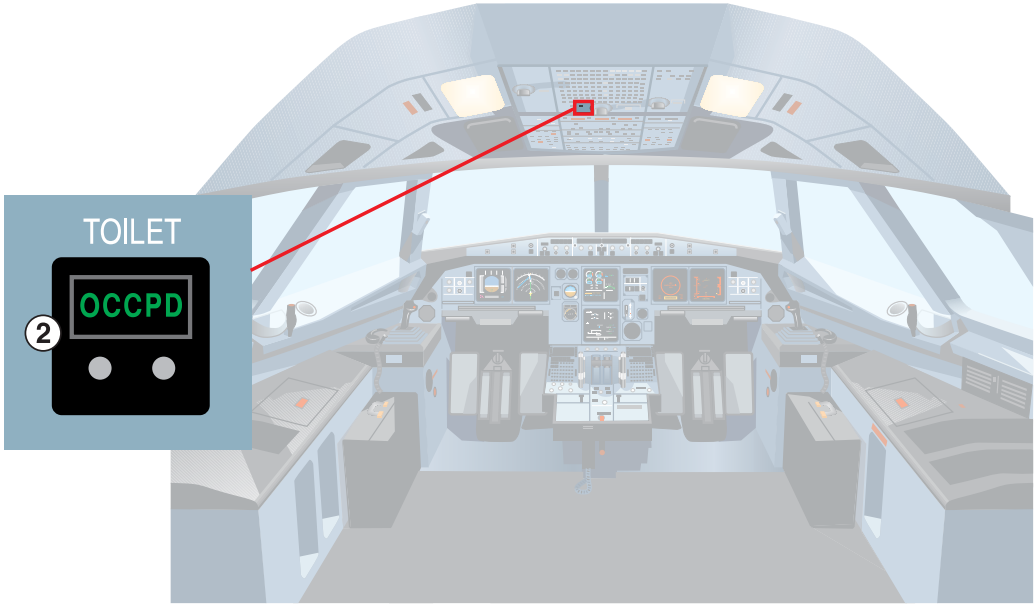
Note: The respective STRIKE light illuminates if a latch fault occurs. The respective CHAN light illuminates if a pressure sensor fault occurs.

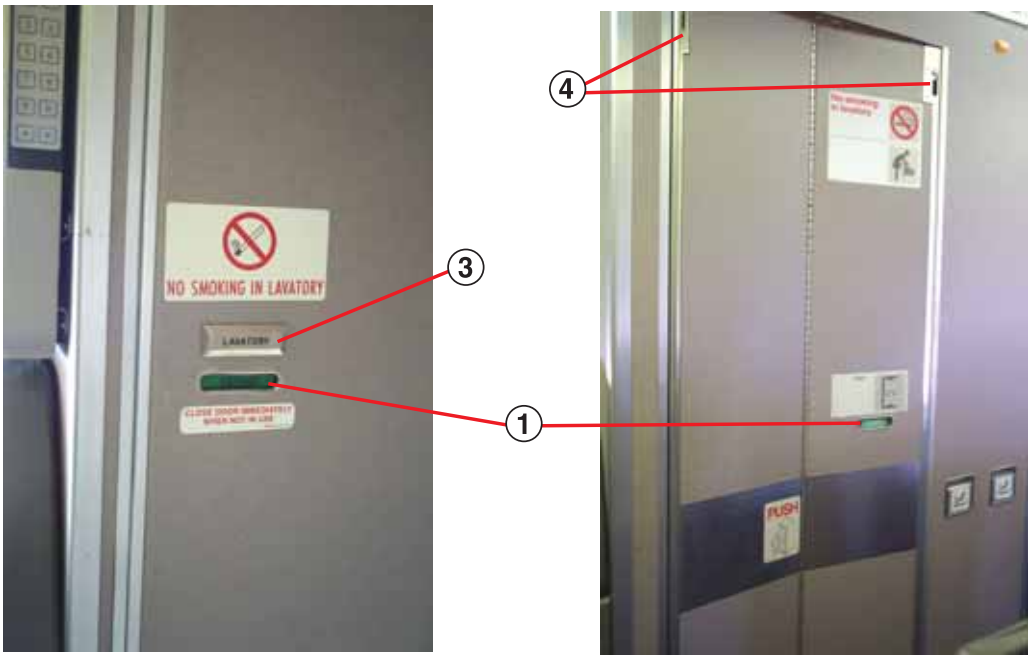
Lavatory Doors

Operation

Both forward and aft lavatory doors are normally locked and unlocked by a sliding control knob on the inside of the lavatory door. Instructions inside the door indicate which direction locks and unlocks the door.

Controls





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Lavatory Doors (Continued)

1	**Occupied Sign**	A vacant/occupied sign is located on both forward and aft lavatory doors for passenger notification.
2	**Cockpit Indicator**	For the forward lavatory, a green OCCPD light is located on the cockpit overhead panel. When lit, it indicates that the forward lavatory is occupied.
3	**Emergency Operation Fwd LAV Door**	The forward lavatory door can also be forced open by raising the LAVATORY sign on the outside of the door and sliding the control inside until VACANT is displayed in the window below.
4	**Emergency Operation Aft LAV Door**	The aft lavatory doors can be forced open in an emergency from the outside by forcing the occupied sign to the vacant position or by removing the quick release hinges on the door.

Chapter 56: Windows

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General Description 56.10.1
Flight Deck Windows 56.10.2
Passenger Cabin Windows 56.10.2
Controls and Indicators 56.20.1
Flight Deck Sliding Window 56.20.1

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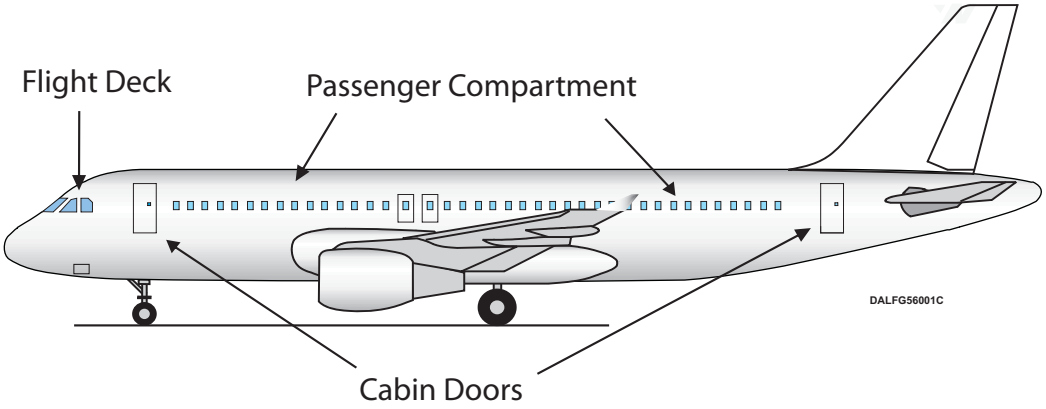
System Description

General Description

Window Categories

There are three categories of windows installed on the A319/320:

- flight deck
- passenger compartment
- cabin door



Flight Deck Windows

Windshields

The windshields consist of two forward, multi-layer panels. Both are heated electrically for protection against bird strikes and to prevent the formation of ice or frost/condensation.

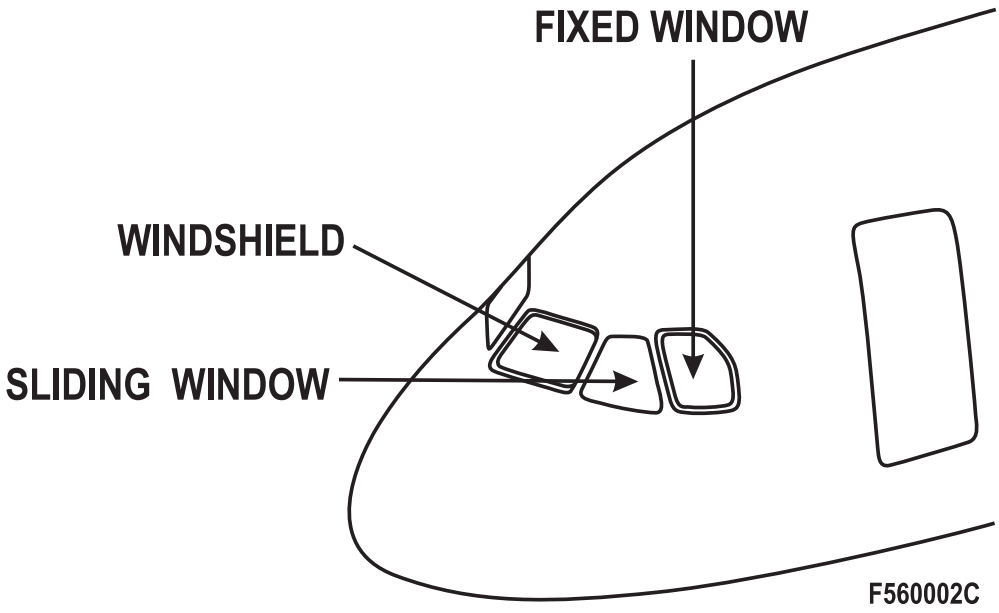
Sliding Windows

The left and right sliding windows are located immediately aft of the windshields. They are multi-layered glass panels. Both can be heated for anti-fogging.

The sliding windows may be opened for smoke removal, side visibility, and for emergency exit.

Fixed Windows

The fixed windows are located aft of the sliding windows. Both can be heated for anti-fogging.



Passenger Cabin Windows

Passenger Cabin Windows

Each passenger compartment window has an inner and outer window pane. Each is capable of carrying the full cabin pressurization differential loads.

Cabin Door Windows

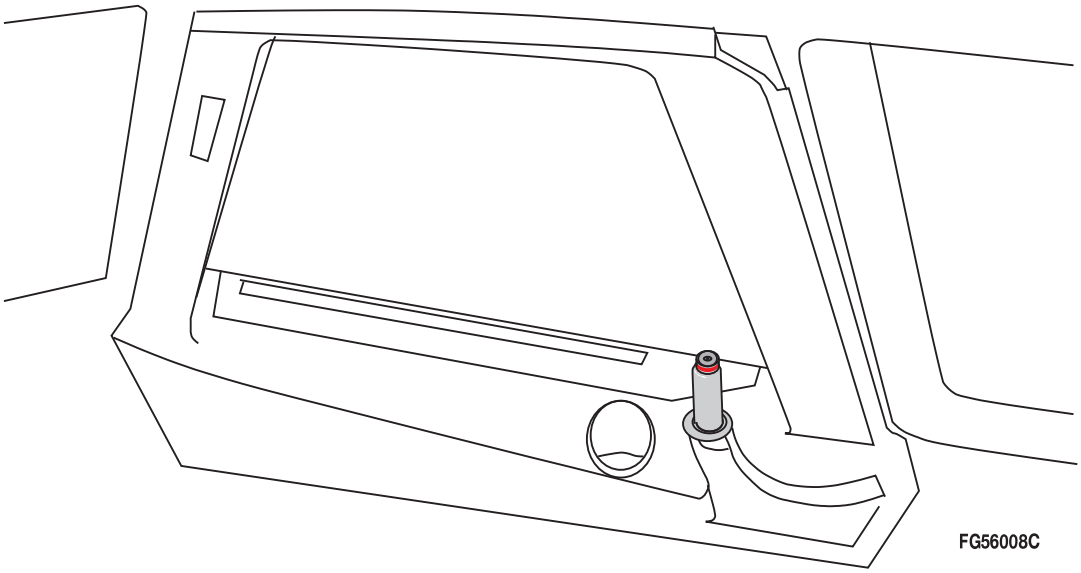
The forward entrance and service door windows are identical in construction to the passenger compartment windows. Each window is recessed in the door structure to allow for wide angle viewing outside of the aircraft.

Controls and Indicators

Flight Deck Sliding Window

Operation

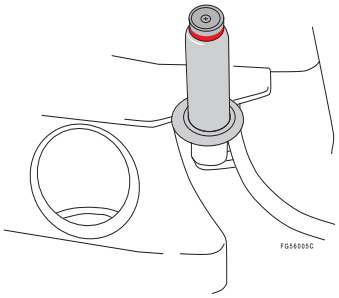
The flight deck sliding window slides rearward and is operated by a control handle. The window may be locked in the open position by a locking pin.



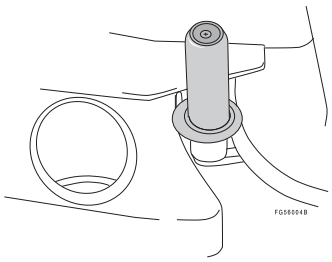
Flight Deck Sliding Window (continued)

Opening

To open the window, grasp the handle and push down on the release button on the top of the handle. Slide the handle inward to unlock the window, then slide the window rearward to open.



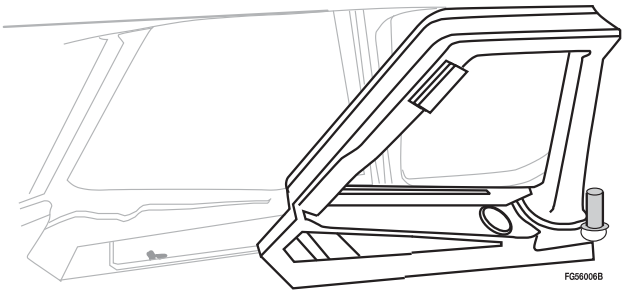
Locked (red showing)



Unlocked

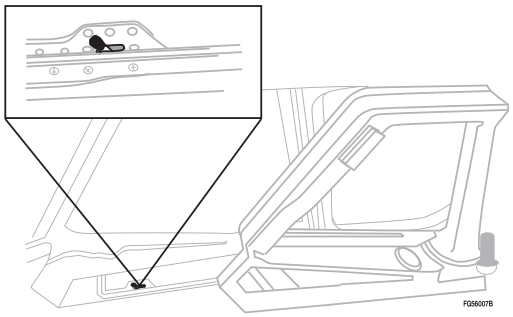
Locking

The flight deck sliding window locks to prevent accidental closing once the window is open 1/3 or greater of its travel distance.



Closing

Move the locking pin aft to unlock the window. Move the window forward until the window frame is full forward. Push the handle outward until the window is locked. The window is locked when the red ring is visible on the release button.



Chapter 58: Emergency Equipment

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Evacuation Slides and Slide/Rafts 58.10.8
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Medical Equipment 58.10.14
Fire Fighting Equipment 58.10.15
Flotation Equipment 58.10.19
Signaling 58.10.22

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Systems Description

General Description

System Overview

The A319 and A320 aircraft are equipped with a variety of emergency equipment classified in the following manner:

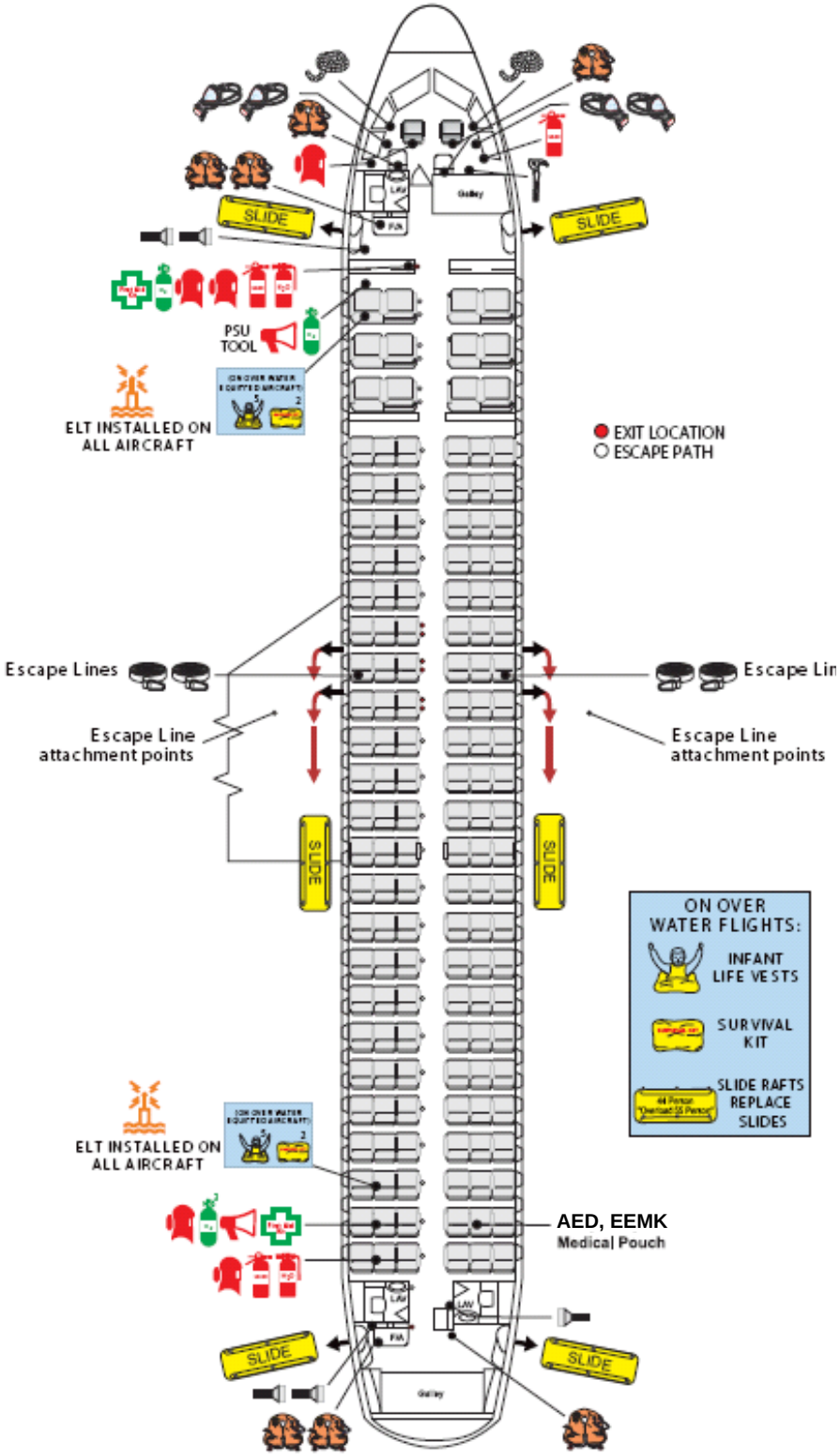
- Emergency evacuation exits
- Slides and Slide/rafts
- General
  - crash axe
  - megaphones
  - emergency flashlights
- Medical
  - Enhanced Emergency Medical Kit (EEMK)
  - medical pouch
  - automated external defibrillator (AED)
  - first aid kits
  - portable oxygen bottles
- Fire fighting
  - fire extinguishers
  - personal breathing equipment (PBE)
- Flotation
  - personal flotation devices
  - passenger seat bottom cushions
- Signalling
  - emergency locator transmitter (ELT)

System Overview (continued)

A320 Emergency Equipment Location

Emergency equipment locations depicted in the following graphics are approximate. For actual locations and quantities, refer to placards located throughout the cabin.

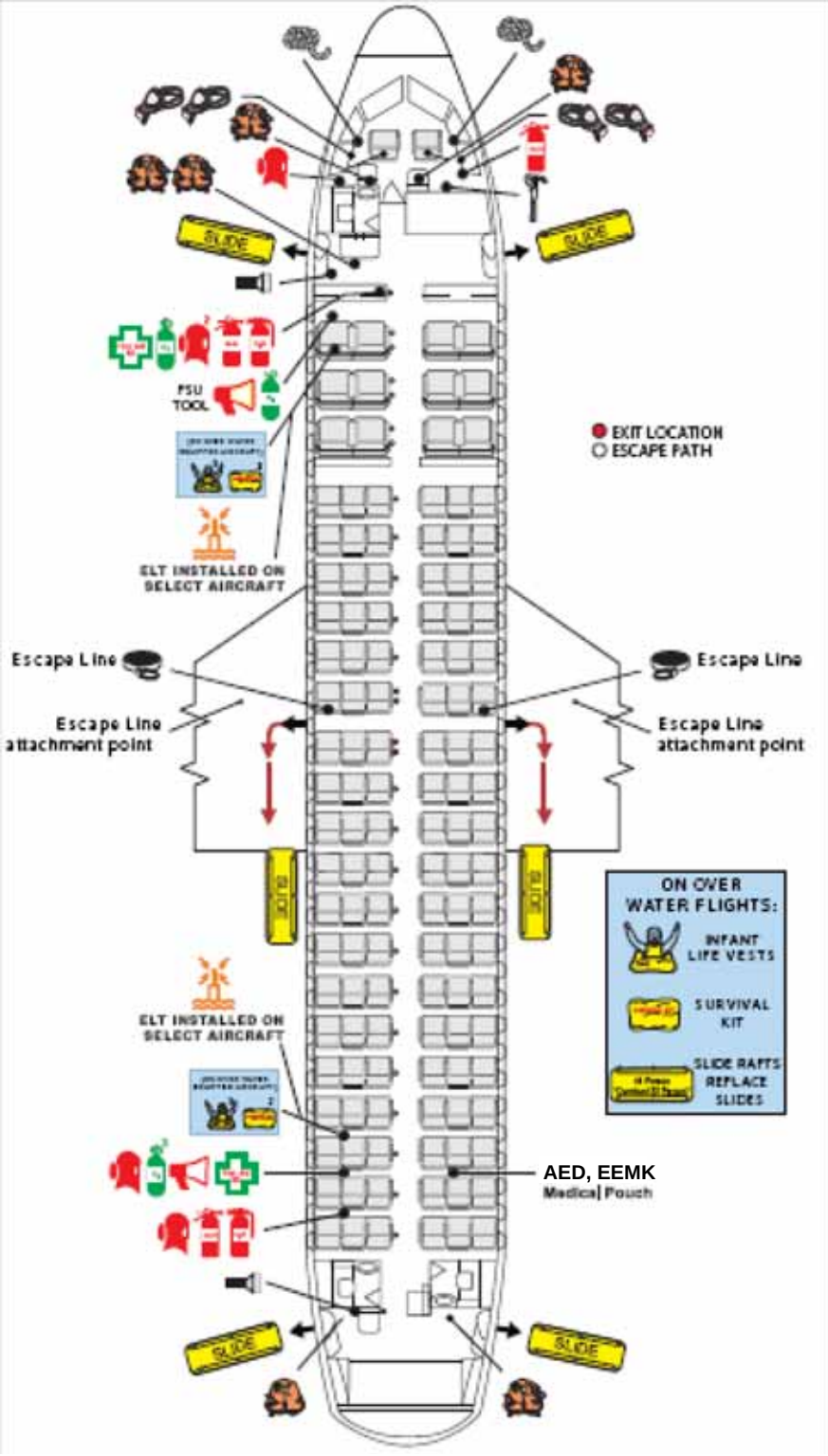
Note: Only a small number of A320 aircraft are equipped for overwater operations.



System Overview (continued)

A319 Emergency Equipment Location

Emergency equipment locations depicted in the following graphics are approximate. For actual locations and quantities, refer to placards located throughout the cabin.

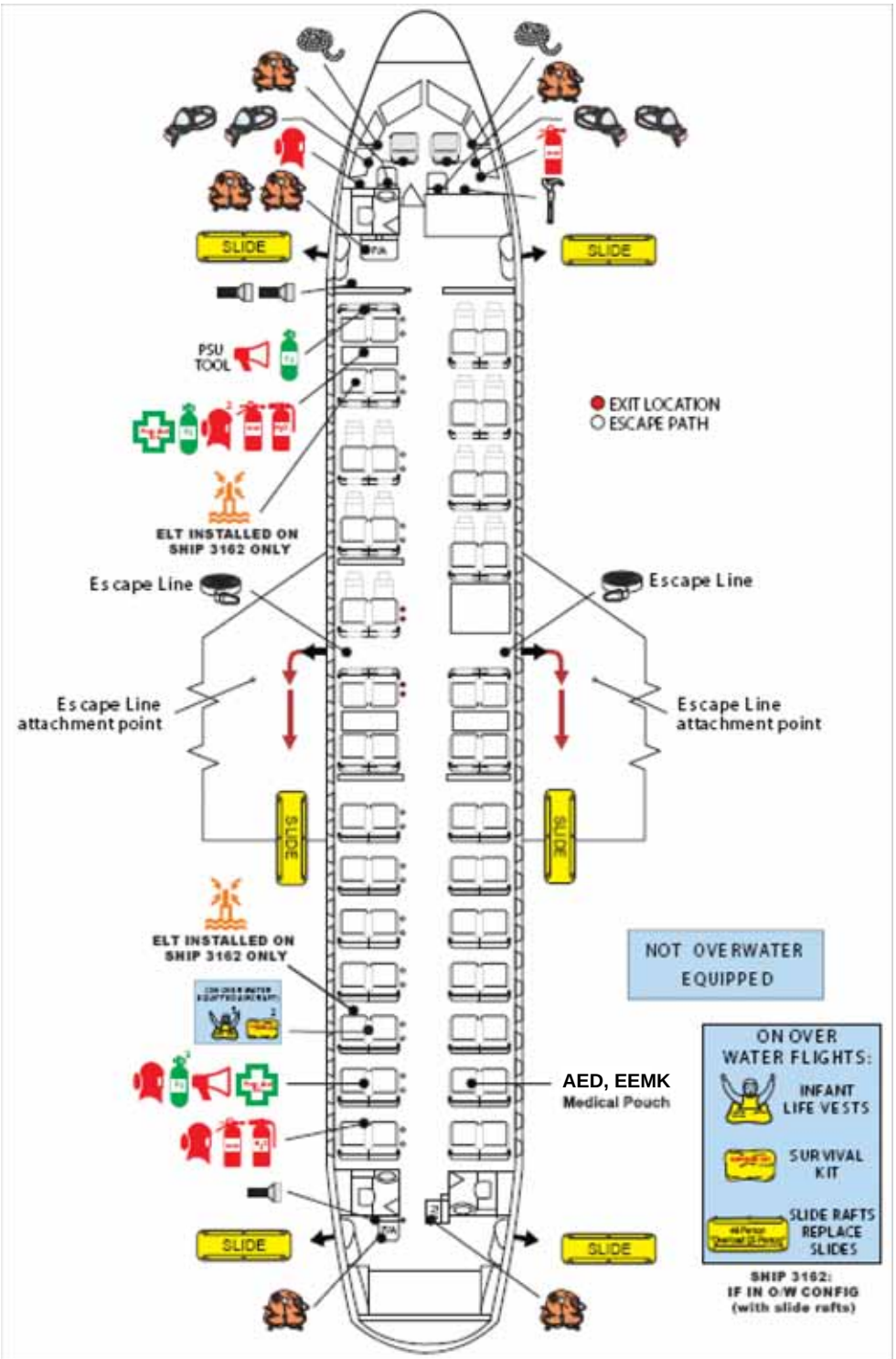


System Overview (continued)

A319 VIP/NBA Configuration Emergency Equipment Location

The diagram below shows location of all emergency equipment found the A319 aircraft which have been configured to support the VIP/NBA charter operation.

Note: These aircraft are not equipped for overwater operations.



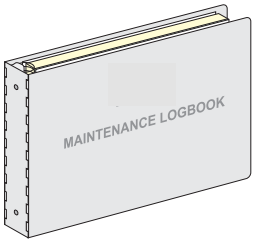
System Overview (continued)

Overwater Operations

A small number of A319/320 aircraft are equipped with the required emergency equipment in order to perform overwater flights. Overwater emergency equipment includes:

- slide/rafts at each cabin door,
- two (2) survival kits,
- adult and Infant life vests, and
- an Emergency Locator Transmitter (ELT).

A placard located within the ship's maintenance log book, identifies it as being overwater equipped.



THIS AIRCRAFT IS AUTHORIZED FOR EXTENDED OVERWATER OPERATION

NOT AUTHORIZED FOR EXTENDED OVERWATER OPERATION

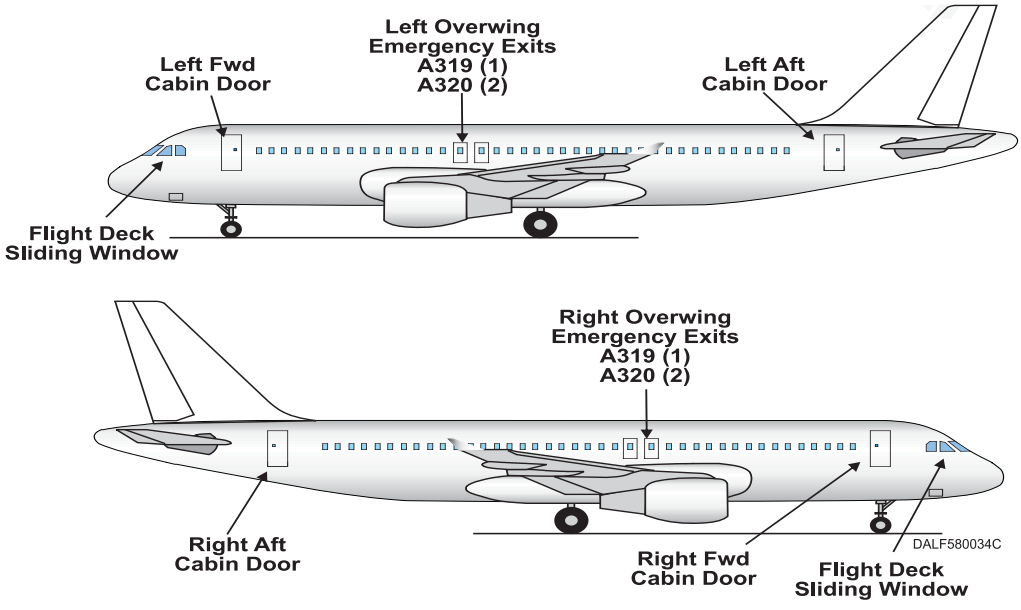
2/99 F580013B

Evacuation Exits

General

Both the A319 and A320 are equipped with 4 cabin doors which provide a means of emergency evacuation from the passenger cabin. In addition, both aircraft are equipped with overwing exits. The A320 has 2 overwing exits on each side of the fuselage however, the A319 has only 1 overwing exit per side.

In addition, sliding widows on both aircraft provide a means of emergency evacuation from the flight deck.

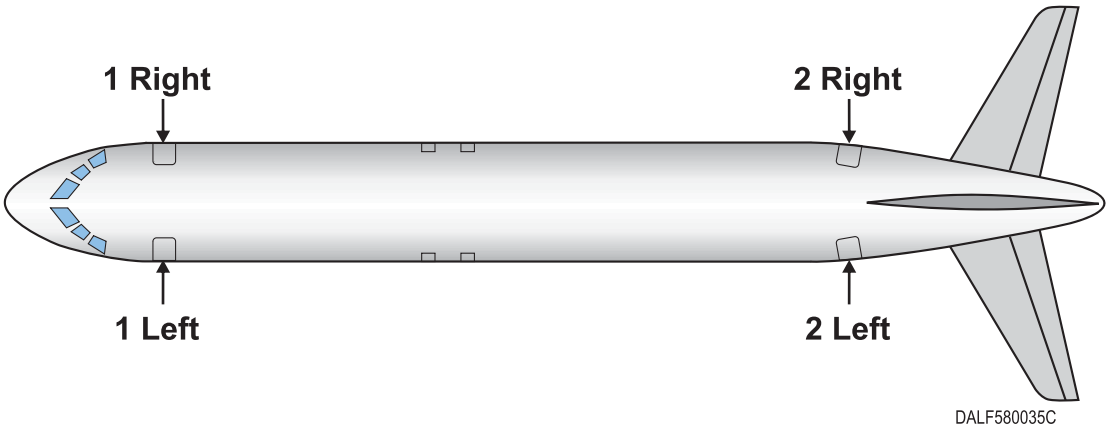


Evacuation Exits (continued)

Cabin Doors

Each cabin door is capable of providing an emergency escape route for both ground and water evacuation.

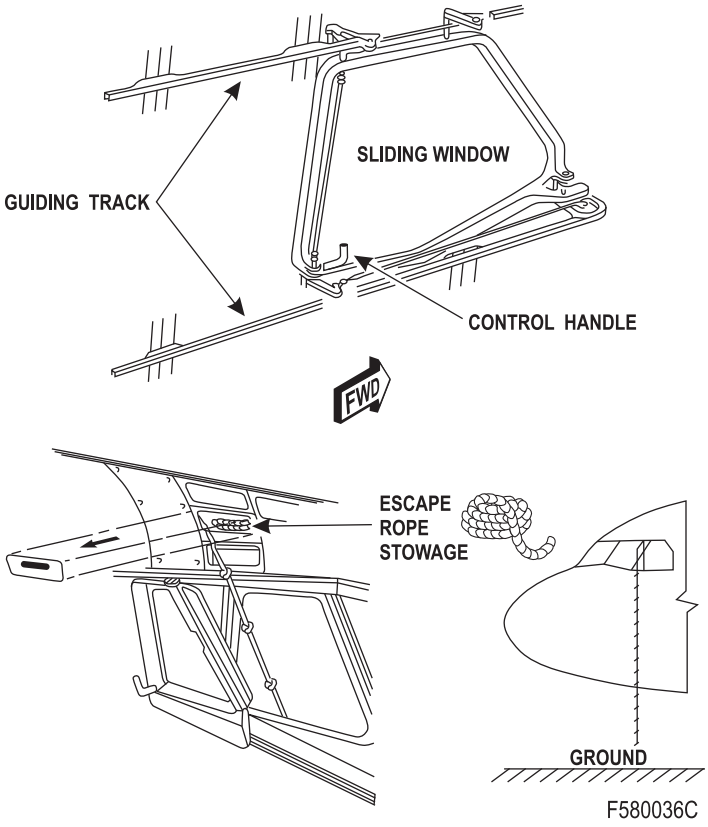
Note: See Chapter 52, Doors, for information concerning cabin door operation.



Flight Deck Windows

The two sliding windows on the flight deck provide an emergency escape route for the flight crew. A small compartment above each window contain escape ropes that are long enough to reach the ground when lowered from either sliding window.

The flight deck windows can only be operated from inside the flight deck.



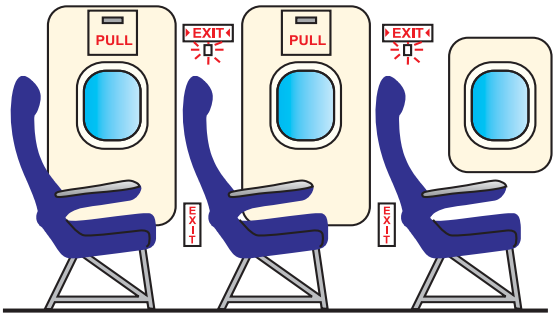
Evacuation Exits (continued)

Overwing Emergency Exits

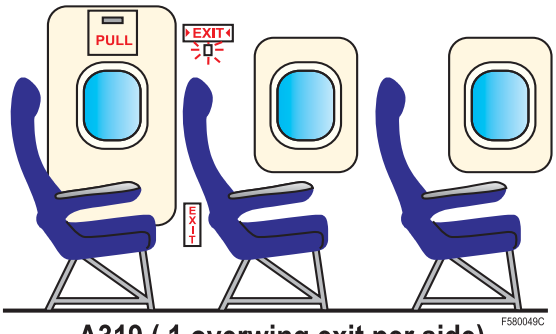
Inward opening overwing emergency exits, located on each side of the center cabin, provide a means of emergency evacuation over the wings.

The A320 aircraft is equipped with two overwing emergency exits on each side of the cabin. However, the A319 is only equipped with one overwing emergency exit per each side.

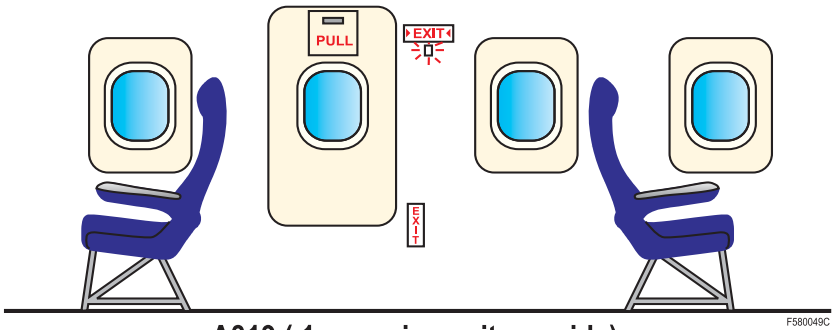
See Chapter 52, Doors for further information on Overwing Exit operation.



A320 (2 overwing exits per side)



A319 (1 overwing exit per side)



A319 (1 overwing exit per side)
VIP/NBA Configuration

Evacuation Slides and Slide/Rafts

Overview

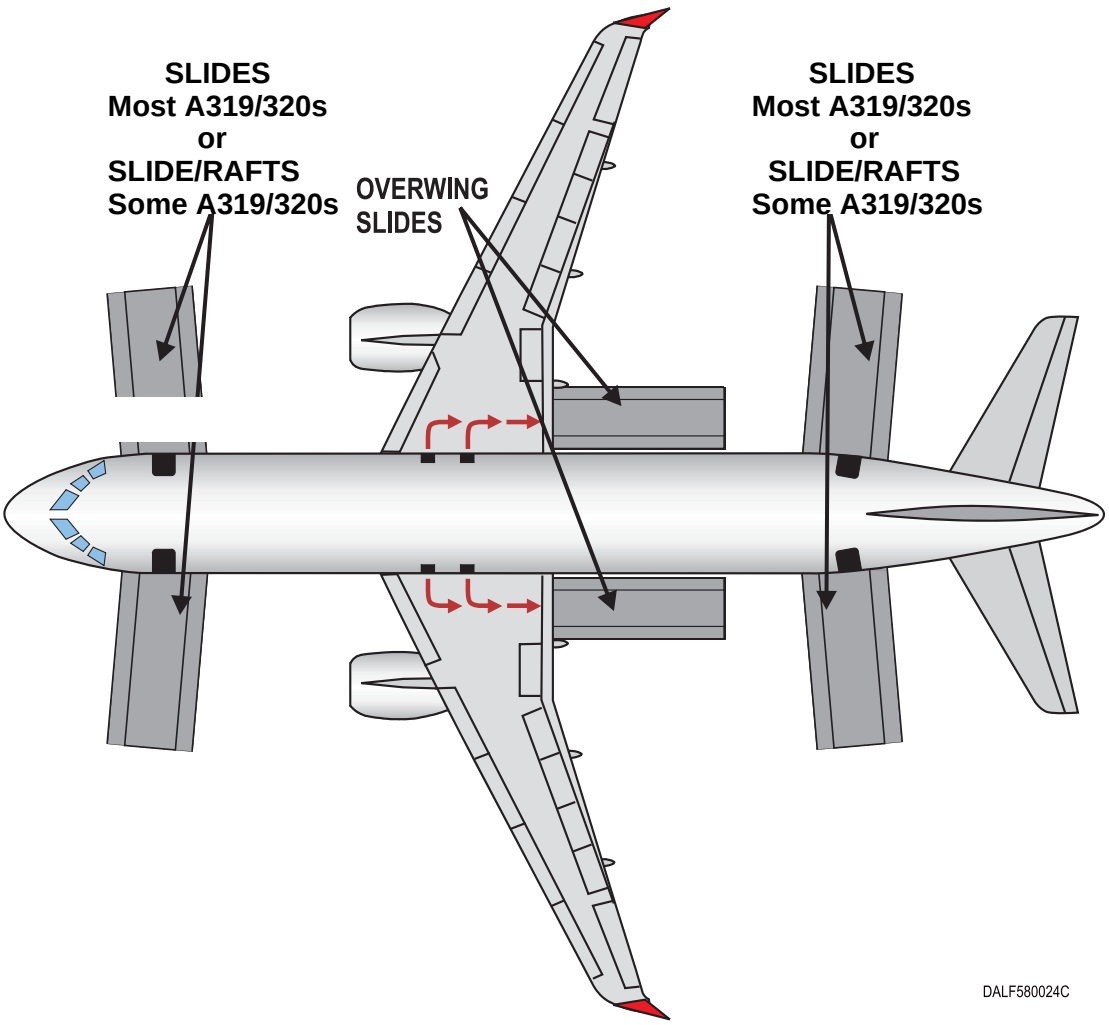
The majority of A319/320 aircraft are equipped with emergency escape slides at each cabin door. The slides facilitate emergency evacuation from the cabin to the ground.

A small number of A319/320 aircraft are equipped for overwater operations. On these aircraft, the slides are replaced with slide/rafts. Slide/rafts can be used as conventional slides or can be detached from the fuselage and used as survival rafts.

Note: In the event a slide or slide/raft subsequently deflate, it can continue to be used as a slide for ground evacuation. It will require four able-bodies, using handles at the bottom of the slide, to form a chute.

In addition, all A319s and A320s are equipped with two overwing evacuation slides which, when deployed, afford evacuation from the inboard trailing edged of each wing.

Note: Overwing evacuation slides cannot be detached from the airframe.



Evacuation Slides and Slide/Rafts (Continued)

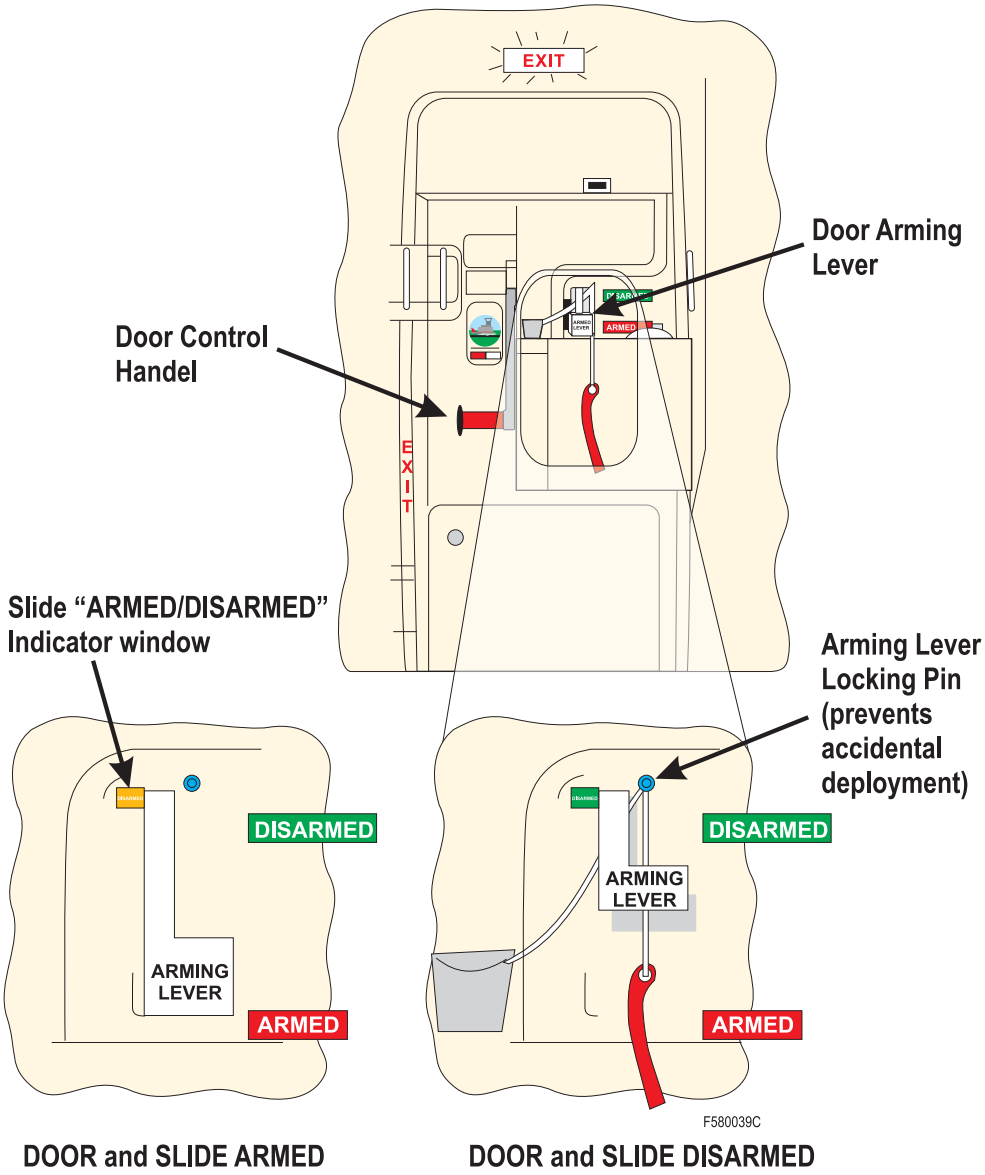
Cabin Door Slide Arming and Deployment

Whether the aircraft is equipped with slides or slide/rafts at each cabin door, they are armed for deployment by placing the door arming lever to the ARMED position.

When armed, the slide and slide/raft will automatically deploy and inflate when the respective door's interior control handle is raised.

In the event automatic inflation fails, a manual inflation handle can be used to manually trigger slide or slide/raft inflation.

Note: Even if armed, slide and slide/rafts will not deploy when the cabin door is opened by use of it's exterior control handle.



Evacuation Slides and Slide/rafts (Continued)

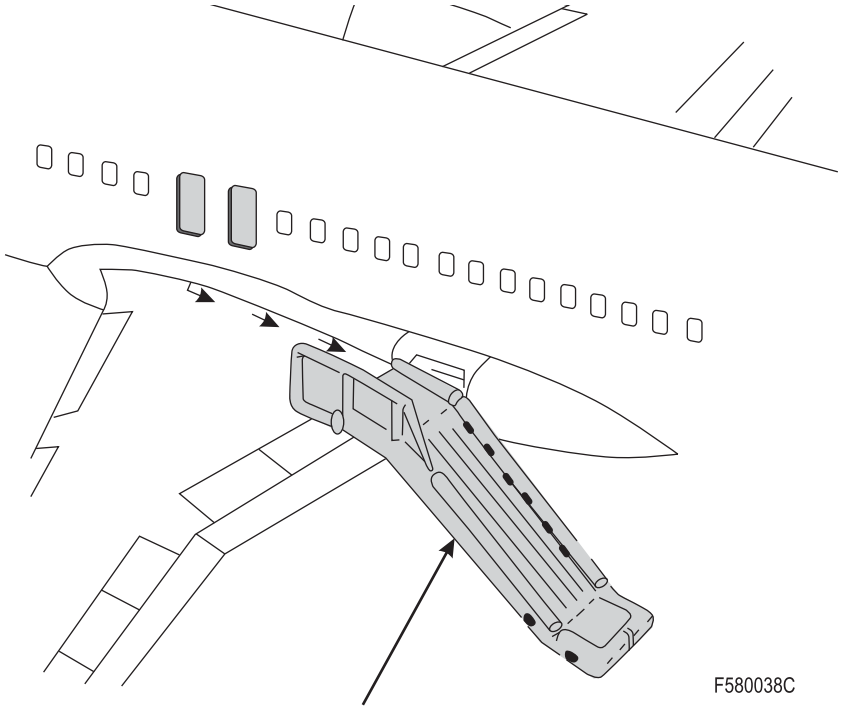
Overwing Slide Arming and Deployment

Emergency evacuation from each wing to the ground is facilitated by overwing escape slides. Overwing escape slides are stored within exterior compartments located just aft of each wing's inboard trailing edge flap.

Overwing escape slides are continuously armed for deployment. The respective escape slide will automatically deployed when an overwing exit on that side of the aircraft is opened.

In the event the slide does not inflate, a manual inflation handle, located within the exit opening frame, can be used to trigger inflation.

Note: Overwing escape slides cannot be detached from the airframe.



Overwing Escape Slide

Evacuation Slides and Slide/Rafts (continued)

Slide/Rafts (Some A319/320s)

Key features of each slide/raft are:

- normal capacity of 44 (overflow capacity 55),
- must be manually detached from the airframe,
- mooring line for keeping the slide close to the aircraft,
- attached knife for severing the mooring line,
- sea anchor with heaving line, and
- internal lights that illuminate upon deployment. (Lights are powered by the aircraft electrical system while attached to the aircraft, then by a water-activated battery once detached.)

Survival Kits (Some A319/320s)

A319/320 aircraft which perform overwater flight operations are equipped with 4 survival kits.

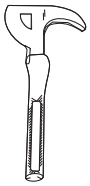
Note: Survival kits are not stored within the slide/rafts, they are stored in the cabin overhead bins and, must be manually removed: two in the 2nd left overhead bin and two in the 3rd to last left overhead bin. (See Emergency Equipment Location diagram for locations.)

Each survival kit contains the following:

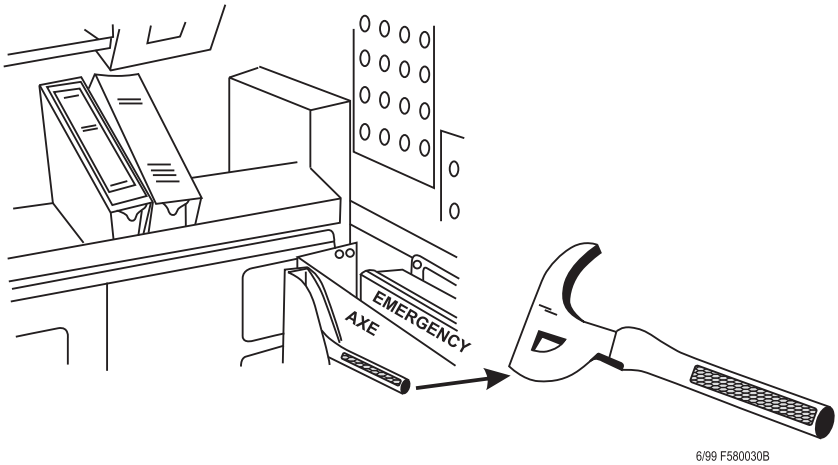
- day-night flares,
- water activated flash lights,
- signal mirror,
- whistle,
- sponges,
- pen knife,
- survival manual,
- survival rations,
- drinking water,
- hole plugs,
- sea dye marker,
- bailing bucket,
- water purification tablets,
- repair kits, and
- canopy kit.

General Emergency Equipment

Crash Axe



An emergency crash axe facilitates escape or rescue. The insulated handle guards against electrical shock. The crash axe is stored on the bulkhead behind the first officer.



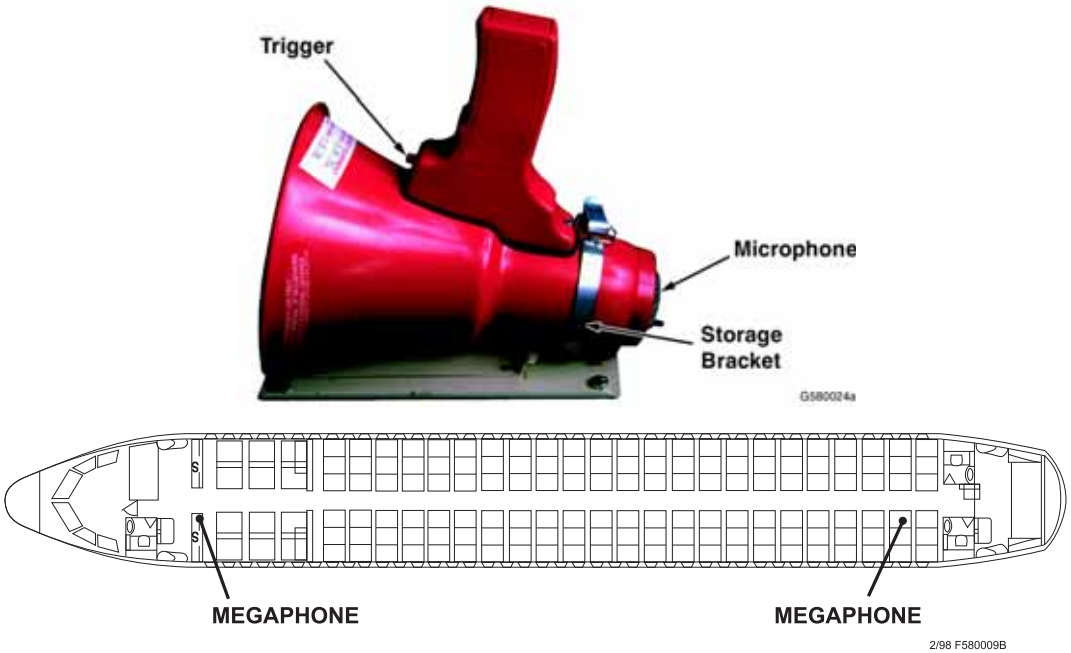
Megaphones

Two battery powered megaphones provide backup should the aircraft PA system fail.

The megaphones are located in the:

- front of the aircraft, adjacent to the left forward main cabin door in a dedicated bin with a transparent cover
- rear of the aircraft, in the last full-sized aft overhead bin, aircraft left

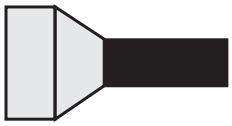
To operate, press the trigger and speak into the microphone.



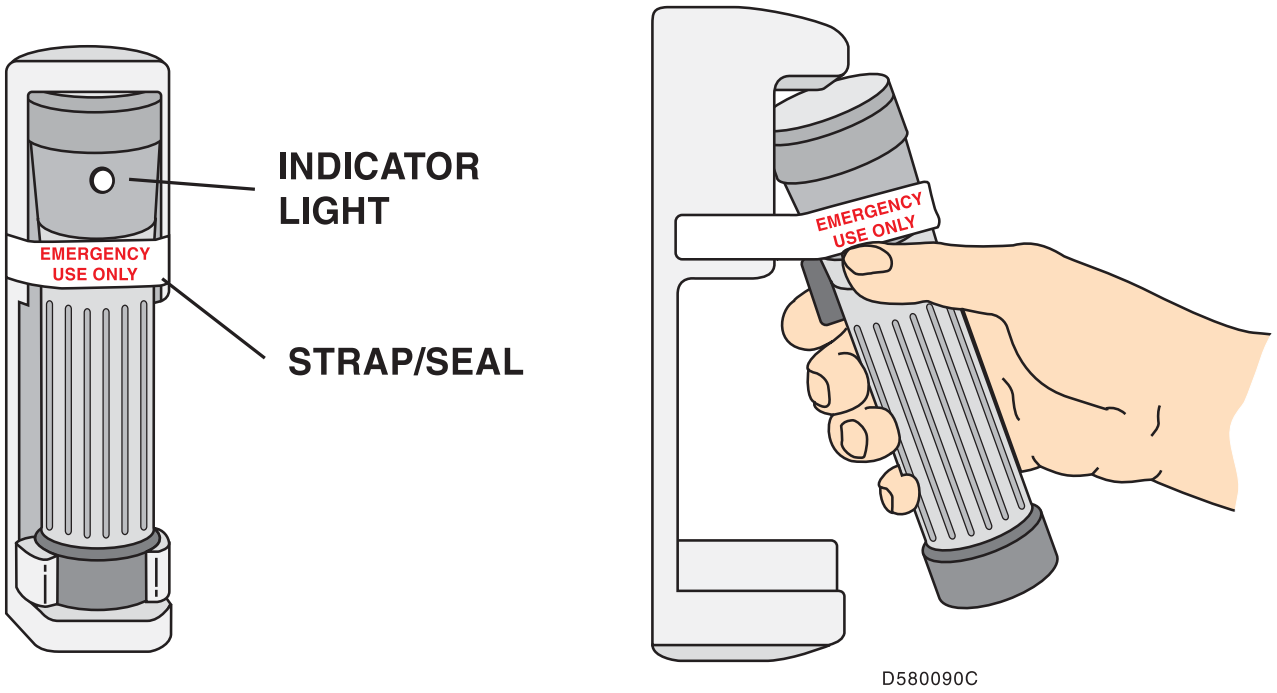
Note: Some megaphones have a volume control that prevents acoustical feedback.

General Emergency Equipment (continued)

Emergency Flashlights



All aircraft are equipped with portable flashlights (see emergency equipment location diagram in this chapter for specific locations). A plastic strap/seal attached to a mounting bracket retains each flashlight. Flashlight batteries are non-rechargeable and are independent of the aircraft's emergency lights system or the aircraft's electrical system. A battery indicator light flashes at least once every 15 seconds to indicate adequate power.

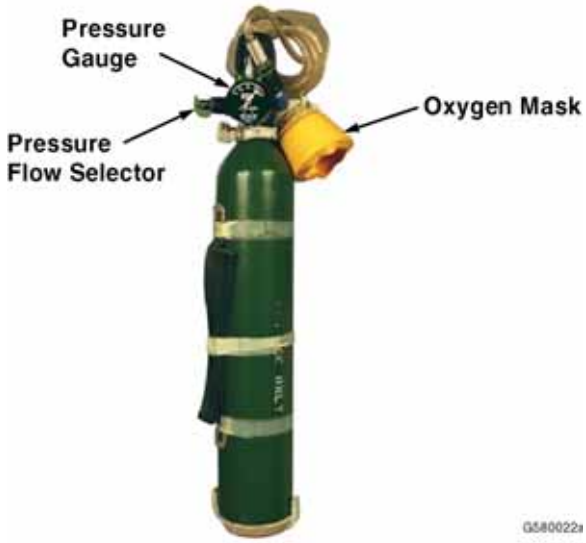


Note: For emergency use only. Removal destroys the plastic strap/seal.

Medical Equipment

Portable Oxygen Bottles

Five portable oxygen bottles, each with an attached yellow emergency passenger oxygen mask, are stowed in the cabin (see emergency equipment location diagram in this chapter for specific locations).



Note: Refer to Chapter 35, Oxygen, for bottle operation.

Fire Fighting Equipment

Fire Extinguishers

Halon and water fire extinguishers are on all aircraft. Each operates differently and is used on different types of fires.

> **Warning**
>
> **If a fire extinguisher is to be discharged in the flight deck, all flight crewmembers must wear oxygen masks and smoke goggles, and select oxygen to 100% and EMERGENCY. A crewmember should don a PBE when fighting fires away from the flight deck.**

Halon Fire Extinguishers

Halon extinguishers should be used on electrical and flammable liquid fires. Halon, when discharged, vaporizes and extinguishes the fire by chemically interrupting combustion. The agent does not cool the burning materials, and, if the materials are hot enough, they may re-ignite after the extinguishing agent disperses. Halon may be used on a combustible fire, if backed up by a water extinguisher. A gauge on the extinguisher indicates the acceptable pressure range.

Halon Fire Extinguisher

Halon extinguishers:

- are not to be used on burning metals
- have a range of approximately 10 feet
- have a safety pin to prevent accidental discharge

To operate:

- pull the safety pin
- hold the extinguisher upright
- aim at the base of the fire
- squeeze the trigger

Fire Fighting Equipment (continued)

Water Fire Extinguishers

Water fire extinguishers should be used on ordinary combustibles (i.e., wood, cloth, paper, rubber, plastic). These extinguishers contain a solution of water and antifreeze which should *not* be used on electrical or grease fires.

Water Fire Extinguisher

Water extinguishers:

- have a range of approximately 25 feet
- are not pressurized until the CO_2 cartridge, inside the extinguisher handle, is discharged

To operate:

- rotate the handle fully clockwise to breaking the wire seal and puncture the CO_2
- hold the extinguisher upright
- aim at the base of the fire
- press the trigger

Fire Extinguisher Operation

Regardless of the type of extinguisher being used, for best results:

- start at the recommended distance
- attack the base of the fire
- use a sweeping motion while progressing towards the back of the fire
- move closer to the fire as the flame subsides

Caution: *Do not discharge the fire extinguisher at too close a range (less than 8 to 10 feet). The high velocity stream may cause scattering of the burning material.*

The effective discharge time of most hand-held fire extinguishers is 8 to 25 seconds. Therefore, use of the proper fire extinguisher without delay.

Fire Fighting Equipment (continued)

Protective Breathing Equipment (PBE)

Protective Breathing Equipment (PBE) provides protection from smoke and fumes while locating and extinguishing fires. When donned properly, the PBE provides a breathable atmosphere for 15 minutes.

Oxygen is discharged for approximately 7-8 minutes, and scrubbers eliminate CO_2 from the hood providing an additional 7-8 minutes of use. The CO_2 scrubbers, while operating, generate heat that may be felt on the back of the neck.

A PBE is comprised of a smoke hood, a neck seal, two oxygen supply cylinders, carbon dioxide scrubbers, and a timer that operates green and red indicator lights.

Note: When in their seats, flight deck crew members normally use the quick donning mask and smoke goggles for protection from smoke or fumes.

When locating or extinguishing a fire while wearing a PBE, move no closer to the fire than the range of the fire extinguisher.

PBE Location and Storage

Five PBEs are provided: One on the flight deck and four in the cabin (see emergency equipment location diagram in this chapter for specific locations).

Each PBE is contained in a vacuum sealed, red tear-away pouch. The storage pouch is equipped with a color coded humidity indicator. The color blue indicates acceptable humidity levels.

Note: Provided the pouch is not damaged, a loss of the vacuum seal is acceptable providing the humidity indicator is blue.

Each pouch is secured by a storage bracket. Plastic seals are mounted on both sides of the open end of the stowage bracket. A broken or missing seal indicates possible tampering with the PBE pouch.

Fire Fighting Equipment (continued)

PBE Operation

To use the PBE:

- removed it from its pouch
- while holding each oxygen cylinder, separate them apart to start oxygen flow into the smoke hood (a green light located within the smoke hood illuminates indicating a properly functioning PBE)

- place each hand, one at a time, into the neck seal with the palms facing each other

- open the seal as far as possible and don the PBE within 10 seconds of activating oxygen flow:
  - a crewmember who wears glasses should place the neck seal against the back of the head first
  - all hair must be completely tucked into the PBE (have another crew member help, if necessary)
- as the hood inflates, the green light flashes:
  - full inflation takes 1 to 3 minutes
  - if the hood does not inflate and/or the green light does not flash, the PBE is not functioning properly and must be removed immediately
- after 7 to 8 minutes, the sound of oxygen flow will stop but there will still be 7 to 8 minutes of breathable oxygen remaining
- after the oxygen supply has been depleted, (indicated by the hood collapsing or by a flashing red light in addition to the flashing green light) go to a safe area and remove the hood

Warning

Because residual oxygen in the hair and the hood create a possible fire hazard, leave the area immediately before removing the hood.

To remove the hood, place both hands under the neck seal and lift the hood over the head.

Flotation Equipment

Personal Flotation Devices

The following types of personal flotation devices are provided on board the aircraft:

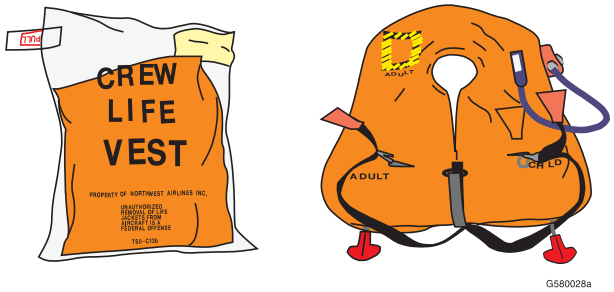
- life vests: crew, adult/child, and infant
- passenger seat bottom cushions

Note: The A319 VIP/NBA aircraft are not equipped with seat cushions that can be used as flotation devices.

Life Vests

Life vests are stored in tamper proof pouches with rip seams and pull tabs for opening. The color of the vest and markings on the pouch indicate the type of vest inside.

Captain and first officer life vests are located in the respective seat backs. Jump seat occupants' life vests are located beneath their seats behind a removable panel. The flight attendants' life vests are located in storage bins near each jumpseat.



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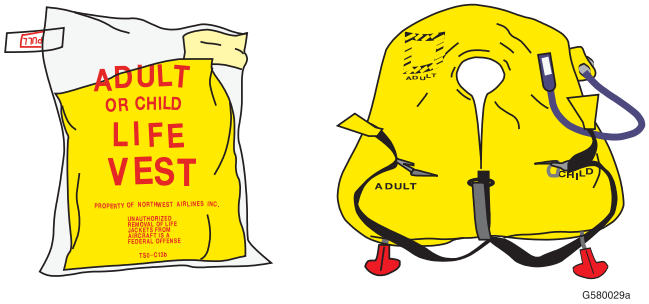
The passenger life vests (adult/child) are located under the passenger seats.



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Five Infant life vests are located in the first class lower storage bin, aircraft left, and five are in the rear of the aircraft in the last full-size overhead bin, aircraft left. Infant life vests accommodate children up to two years old. Each vest is equipped with a tether line and handle.

G580030a

Flotation Equipment (continued)

Life Vest Donning

Crew and adult/child vests are identical in design and operation. The adult/child vest accommodate adults and children over the age of two. The vests have two separate inflation chambers. CO_2 cartridges inflate each chamber. Pulling the associated inflation handle discharges the cartridge. Each chamber is also equipped with a manual inflation tube, used in the event its CO_2 cartridge has failed.

Warning

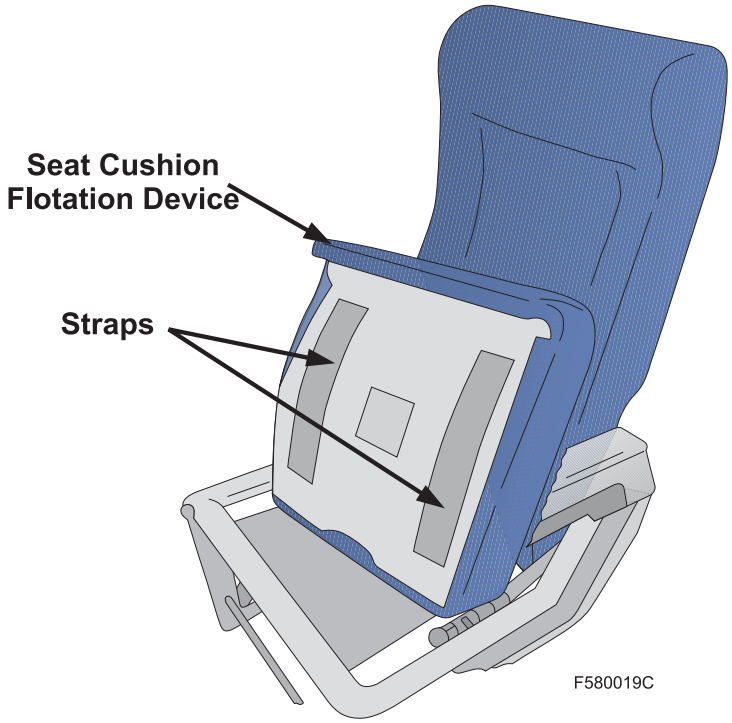
Adults should don life vests before existing the aircraft, but should not inflate the vests until outside the aircraft. Vests worn by children and infants should be inflated while still in the aircraft.

All life vests have a water-activated battery that automatically triggers the illumination of a light located on the side of the vest

Flotation Equipment (continued)

Passenger Seat Bottom Cushions

All passenger seat bottom cushions are FAA approved flotation devices. However, in aircraft equipped for extended overwater operations, life vests are the primary means of flotation.



Note: The A319 VIP/NBA aircraft are not equipped with seat cushions that can be used as flotation devices.

A320 Aircraft

On ships 3201-3270, each outboard overwing exit seat (rows 10 & 11) is equipped with a low profile bottom seat cushion. These cushions are of normal length but have less padding compared to other Coach Class seat cushions.

On ships 3271 and up, at row 10, the outboard overwing exit seat cushions are shorter in length but, have normal padding. At row 11, the seat cushions are standard size and padding.

A319 Aircraft

The outboard overwing exit seat bottom cushions (row 9) are standard size. The seat bottom padding is comparable to coach class seat cushions.

Signaling

Emergency Locator Transmitter (ELT)

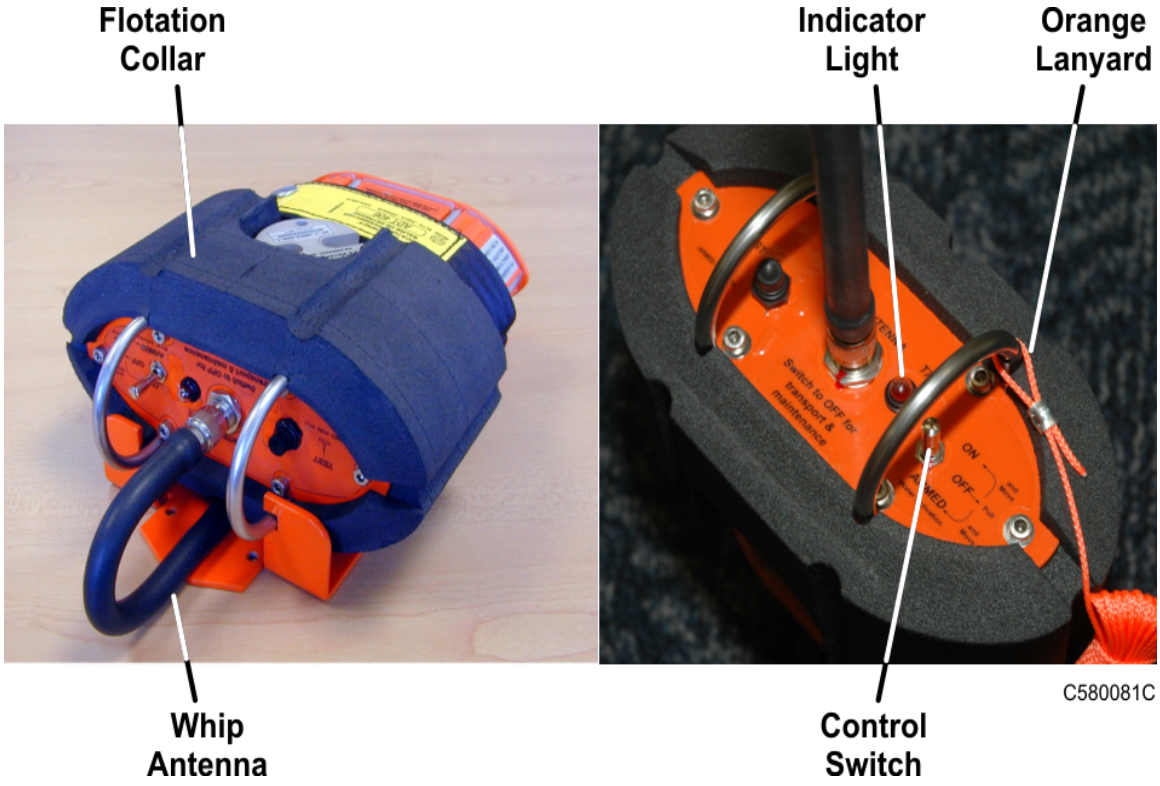
All A320 and some A319 aircraft are equipped with two ADT 406 ELTs which, support the global satellite COSPAS-SARSAT international search and rescue system.

The A319 aircraft which are not equipped with the ADT 406 ELTs will not be equipped with any type of ELT.

Note: See A319 or A320 Emergency Equipment Location diagram for ELT storage location.

Key operating features of the ADT 406 ELT include:

- simultaneous transmission on 121.5MHz, 243.0 MHz and 406 MHz
- global coverage within a 2KM accuracy
- operational battery life of at least 24 hours
- a flotation collar and lanyard.



To operate, the unit must be removed from its mounting bracket, and then it can be activated either automatically or manually:

- Automatic activation - with the control switch in the ARMED position, placing the unit in water will trigger activation.

Note: Each ELT is stored with it's control switch in the ARMED position.

- Manual activation - placing the control switch to the ON position will trigger activation.

When activated, an amber indicator light blinks continuously and a buzzer sounds.

Chapter 72: Engines

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System Description

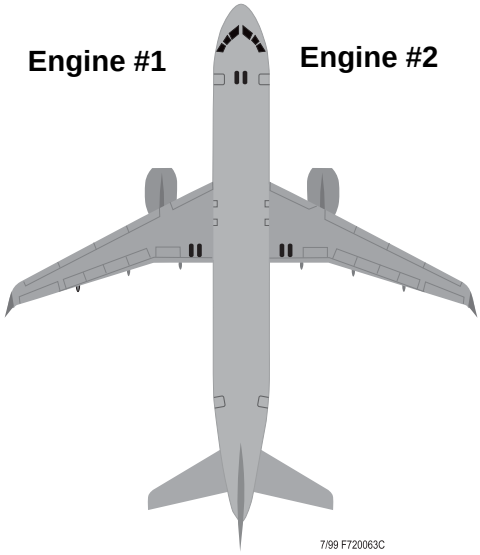
General Description

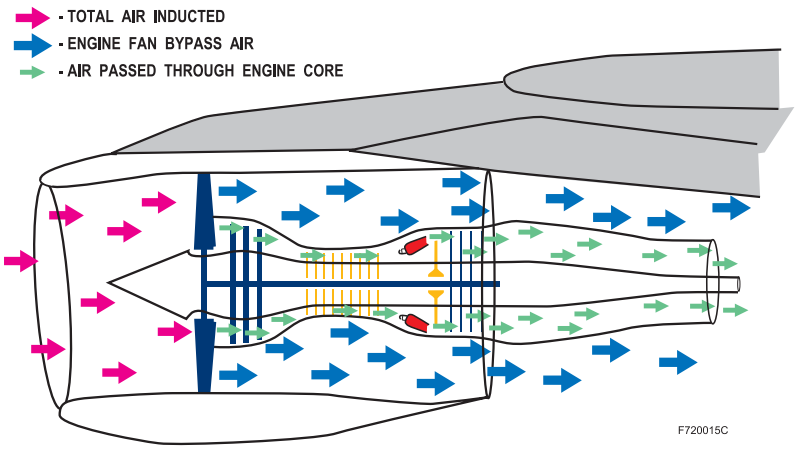
Introduction

The A319/320 is equipped with two wing mounted CFM56 engines. The CFM56 engine is a high bypass ratio engine, with most of the fan air bypassing the engine core. The high bypass ratio results in excellent fuel efficiency and quiet operation.

The engine is a twin spool, axial flow turbofan. There are indications on the Engine/Warning Display (E/WD) for the rotation of the two engine spools (N_1 and N_2). N_1 is the pilot's primary source of engine performance.

The engine has a single combustion chamber equipped with fuel nozzles and two igniters.





Accessory Gear Box

A drive shaft connects the N_2 spool to the accessory gear box. Engine accessories include the:

- lubrication unit, which includes the engine oil pumps,
- engine fuel pumps,
- full Authority Digital Engine Control (FADEC) and FADEC alternator,
- integrated Drive Generator (IDG),
- engine starter,
- hydraulic pump, and
- fuel control unit.

General Description (continued)

Fan Cowl Latches

Each engine's fan cowl is locked in the closed position by three manually operated latches. The cowl latches are located at the 6 o'clock position of the engine.

When unlocked the latches extended perpendicularly from the cowling. When in the locked position, the latches are flush with the cowling.

Warning

When an engine cowl is in the closed position, it may appear to be properly locked, especially when in low light conditions. Therefore, it is critical that each engine's Fan Cowl Latch be visually inspected to ensure proper cowl locking.

Cowl Closed and Locked

Cowl Closed but Not Locked

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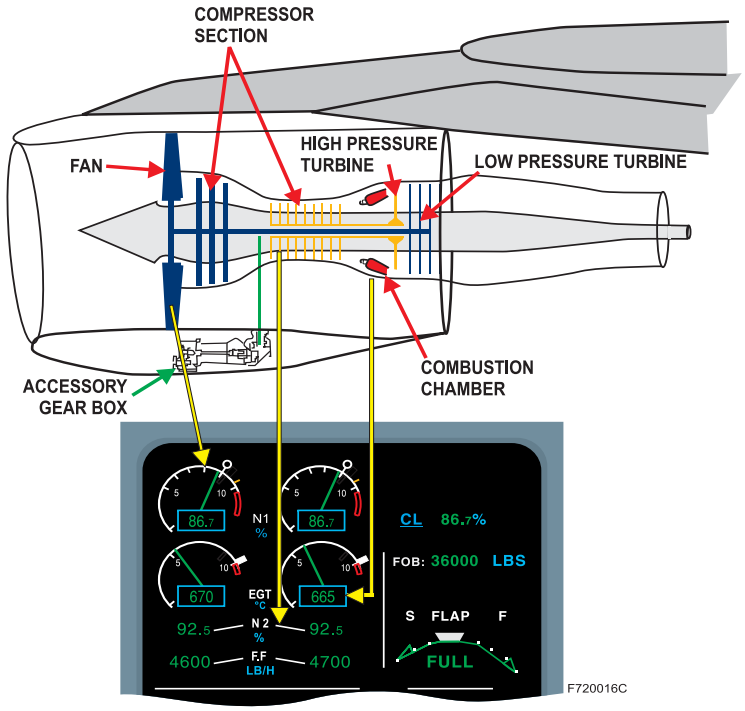
Major Components

The following diagram illustrates the major components of the engine and the corresponding indications associated with each component on the E/WD:



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ENGINE WARNING DISPLAY
(upper ECAM)

Engine Types

Description

Engine Type	Aircraft Model	Thrust
5A-1	A320-211	25,000 lbs
5A-3	A320-212	26,500 lbs
5A-5	A319-114	23,500 lbs

All engine types are equipped with hardware that is almost identical. The primary difference between the types is the FADEC program, which limits the maximum thrust output. The actual engine EGT is also limited, however, the FADEC program adjusts the “numeric” EGT displayed, so that all engine types display the same EGT values on the E/WD. This allows pilots to use the same EGT limits for all engines.

Because the engines are “flat rated”, the only increase in thrust between engine types (5A-1 vs.5 A-3) on the same aircraft (e.g., A320) occurs at takeoff thrust. Thrust output at MCT and below is identical for both A320 models. The same relationship is true for the A319 (5A-5)engine.

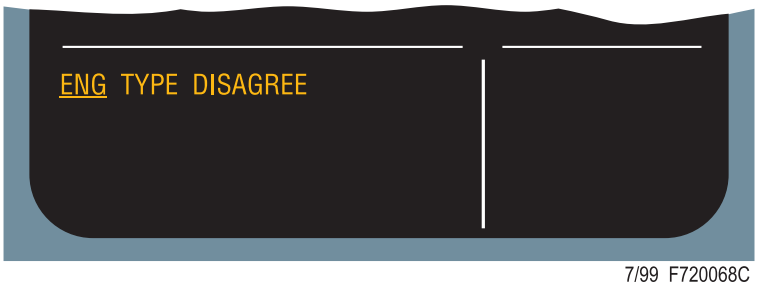
Example: An A320 equipped with 5A-3 engines will not climb faster or cruise higher than one equipped with 5A-1 engines (Except at takeoff thrust).

To ensure that the FMS uses the correct engine performance data, the MCDU A/C STATUS page displays the aircraft model and engine type loaded in the data base. Each specific aircraft tail number is certified for only one engine/airframe combination.

Engine Intermix

Operation of the aircraft is not authorized unless both engines are the same type.

The engine types are monitored by the FADECs, and if the FADEC programs do not match, an E/WD caution message is displayed.



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Full Authority Digital Engine Control (FADEC)

Description

The FADEC is a computer that interfaces with numerous aircraft systems to control engine operation and performance. Each engine has an independent FADEC. The FADEC is also referred to as an Electronic Control Unit (ECU). Information is provided to each FADEC by an Engine Interface Unit (EIU).

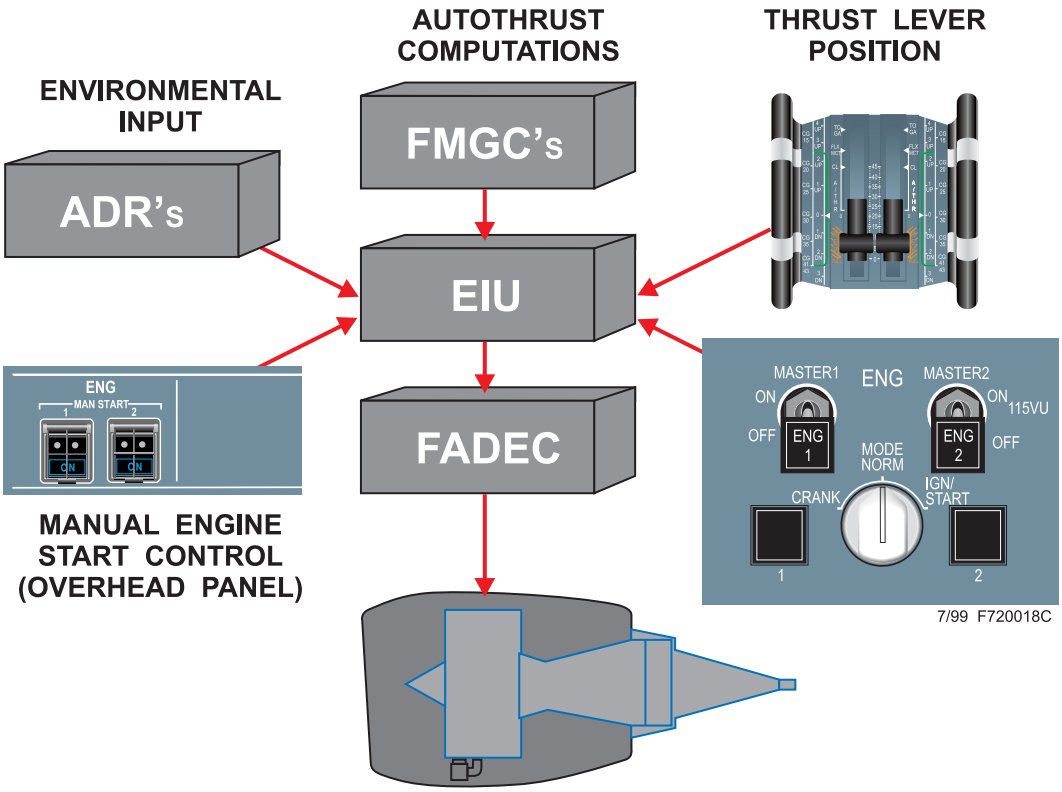
Each FADEC has two channels, and either channel is fully capable of operating the engine. If one channel fails, the other channel takes control. If a FADEC channel failure occurs, an ECAM "ENG 1 FADEC A (B) FAULT" message is displayed.

Engine Interface Unit (EIU)

The EIU receives signals from numerous sources such as the bleed air system, Flight Management System, engine control panels, air conditioning pack zone regulator, etc. The EIU signals the FADEC with appropriate thrust demands.

Each engine has its own independent EIU.

The diagram below shows how various systems provide input to the FADEC. These inputs are processed into performance commands for the engines.



Full Authority Digital Engine Control (FADEC) (continued)

Function

The FADEC controls the engine for maximum fuel efficiency, while automatically protecting the engine from exceeding N_1 and N_2 limits.

Note: Except during automatic starts on the ground and manual starts on the ground below 50%N_2, the FADEC does not protect the engine from exceeding EGT limits.

The FADEC controls the engine at all times in both forward and reverse thrust. The FADEC also provides engine start sequencing. The FADEC automatically computes:

- engine thrust penalties for air conditioning, engine and wing anti-ice and
- engine thrust limits for display on the ECAM Engine/Warning Display (E/WD).

The FADEC commands engine idle increases for:

- bleed demands,
- high engine or IDG oil temperatures, and
- the approach configuration (flaps 1 or greater) if selected while airborne.

Engine Starting

Engine starts are normally accomplished automatically, with the FADEC controlling the start.

Automatic Starts

Once the pilot initiates the start sequence, the FADEC controls the remaining steps. If the engine exceeds a start limit during an automatic ground start, the FADEC interrupts the start, attempts to correct the problem by adjusting fuel flow and/or engine ignition, and continues the start. If the malfunction persists, it aborts the start and dry cranks the engine.

Manual Ground Starts and all Airborne Starts

During manual ground starts the FADAC can only automatically abort the start due to a hot start (high EGT) below 50% N_2. The FADEC does not have start abort authority during airborne engine starts. It will monitor start limits and provide cautions if a limit is exceeded.

Full Authority Digital Engine Control (FADEC) (continued)

Thrust Limiting

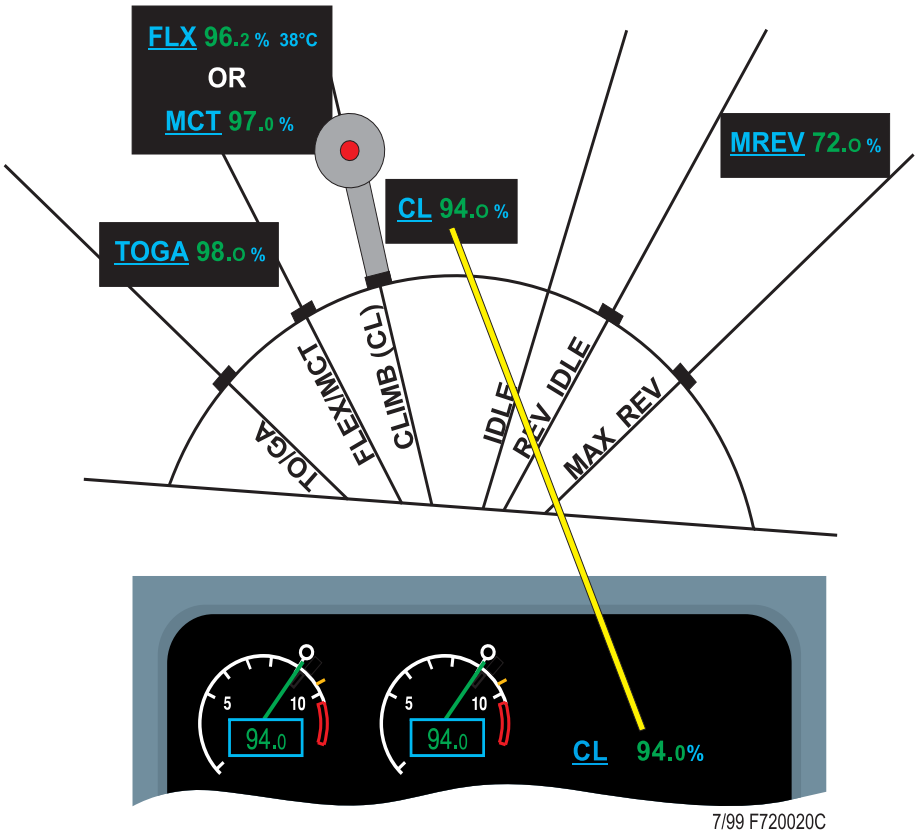
The FADEC computes the maximum thrust for the ambient conditions. These thrust limits correspond to the position of the (most forward) thrust lever. If the thrust lever(s) are between detents, the thrust limit corresponds to the next higher limit.

The FADEC also prevents the engine from exceeding design RPM limits. The FADEC limits engine acceleration and deceleration, avoiding engine stalls and flameouts.

Note: The FADEC does not limit engine EGT, except during automatic ground starts and manual ground starts below 50% N_2. It will provide overtemp cautions and warnings, except when high thrust (above MCT) is selected.

Example: During takeoff, FADEC will not prevent an over temp. Amber ECAM cautions associated with this overtemp are inhibited. The only indication would be the red EGT exceedance warnings.

Thrust limit modes (in blue) and the associated N_1 rating limit (in green) are computed by the FADEC, and are displayed on the upper portion of the E/WD.



In the illustration above, the modes and limits are depicted for example purposes only. Modes and limits will vary depending on the ambient conditions and phase of flight.

Full Authority Digital Engine Control (FADEC) (continued)

FADEC Power Sources

The FADEC is electrically powered by a dedicated alternator when the engine is running, and is normally independent of the aircraft electrical system. The FADEC will revert to aircraft electrical power if the dedicated alternator fails.

The FADEC is powered by the aircraft electrical system following initial aircraft electrical power up for several minutes to accomplish a self test. Following this test, aircraft electrical power will automatically disconnect from the FADEC.

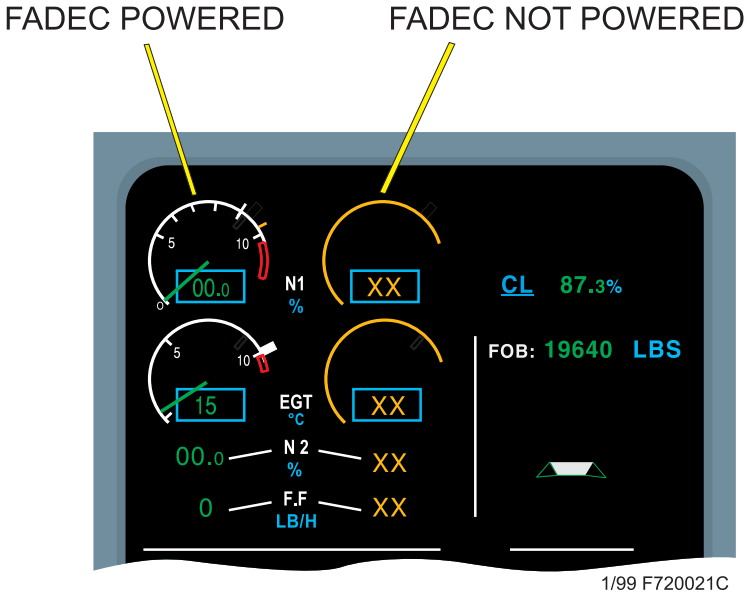
The pilot can power the FADEC with aircraft power prior to engine start by rotating the ENG MODE selector to IGN/START. However, the FADEC generates considerable heat while operating and unnecessary FADEC operation with the engine shutdown should be avoided.

During engine start, the dedicated alternator will automatically power the FADEC when engine rotation is sufficient.

After a normal engine shutdown, the FADEC is again powered by aircraft electrical power. The FADEC remains powered in this configuration for several minutes.

The pilot can recognize that the FADEC is powered by noting engine indications on the E/WD. If the FADEC is not powered, the engine indications are replaced by amber XXs.

Note: Selecting and releasing an ENG FIRE pb isolates aircraft electrical power from that FADEC. It will remain self powered if engine rotation is sufficient.



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Caution: *Pulling a EIU, ECU, or FADEC circuit breaker with the engine running may result in complete FADEC power failure, and a failure of the associated engine.*

Thrust System

General

There are two thrust levers located in the center of the pedestal. The thrust levers are used for making both manual and autothrust (A/THR) thrust selections. Thrust control is completely electronic. There is no mechanical connection between the thrust levers and the engines. The position of each thrust lever, or Thrust Lever Angle (TLA), is electronically measured. Unlike some autothrust systems, the thrust levers do not move on their own.

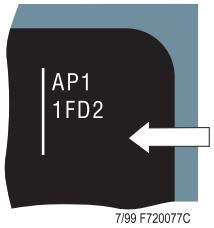
The thrust levers operate similar to conventional thrust levers in manual thrust, with engine thrust directly related to the thrust lever position. The thrust levers have six positions, or detents, and are described in section 72.20, Controls and Indicators.

Manual Thrust

Manual thrust is used when the A/THR is not active. In this case, the thrust levers operate similar to conventional thrust levers and directly command engine thrust. The FADEC continues to control and monitor the thrust to prevent it from exceeding computed RPM limits. Manual thrust is in effect when the A/THR is not active.

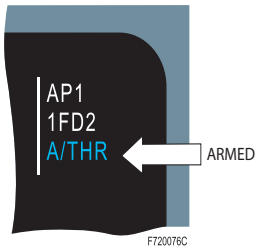
When A/THR is not armed, the FCU A/THR pb is not illuminated.

Column 1 of the FMA is blank and no A/THR annunciation is displayed in column 5.



When the A/THR is armed, but not active (thrust levers outside the active range), the FCU A/THR pb is illuminated.

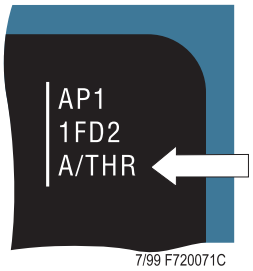
If the FMA A/THR annunciation in column 5 is blue, A/THR is armed, but not active.



Thrust System (continued)

Autothrust

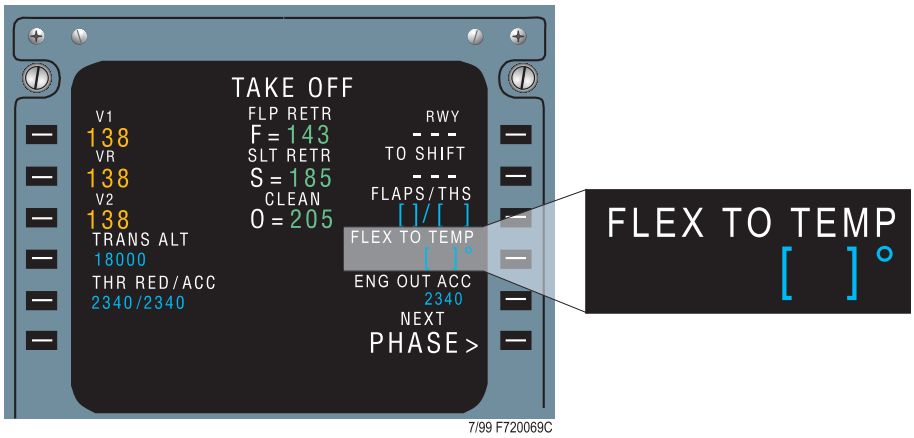
When autothrust is active, the FCU A/THR pb is illuminated, and the A/THR indication in column 5 of the FMA is white.



The thrust levers do not move when the A/THR is active. The maximum allowable thrust is limited to the position of the thrust levers. Autothrust is described in detail in chapter 22, Autoflight.

FLEX Takeoff Thrust

Flex thrust takeoffs are considered normal, with TOGA being the exception, used only when conditions do not permit FLEX. Assumed FLEX temperatures are entered on the MCDU PERF TAKEOFF page.



If the thrust levers are placed into the FLEX/MCT detent on takeoff, and a FLEX temperature has not been entered, a MASTER CAUTION and ECAM ENG FLEX TEMP NOT SET message is displayed. Advancing the thrust levers to TOGA allows the takeoff to be continued, and erases the caution message.

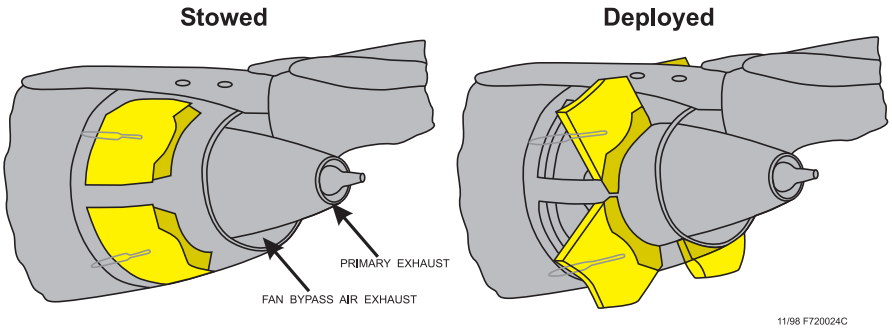
If a FLEX temperature has been entered, and a TOGA takeoff is desired, the thrust levers can be advanced to the TOGA stop without erasing the FLEX temperature on the TAKEOFF page.

Caution: *The FLEX temperature is not erased from the FMS if the runway is changed in the flight plan. After a runway change, ensure that a FLEX temperature is still authorized for the new runway.*

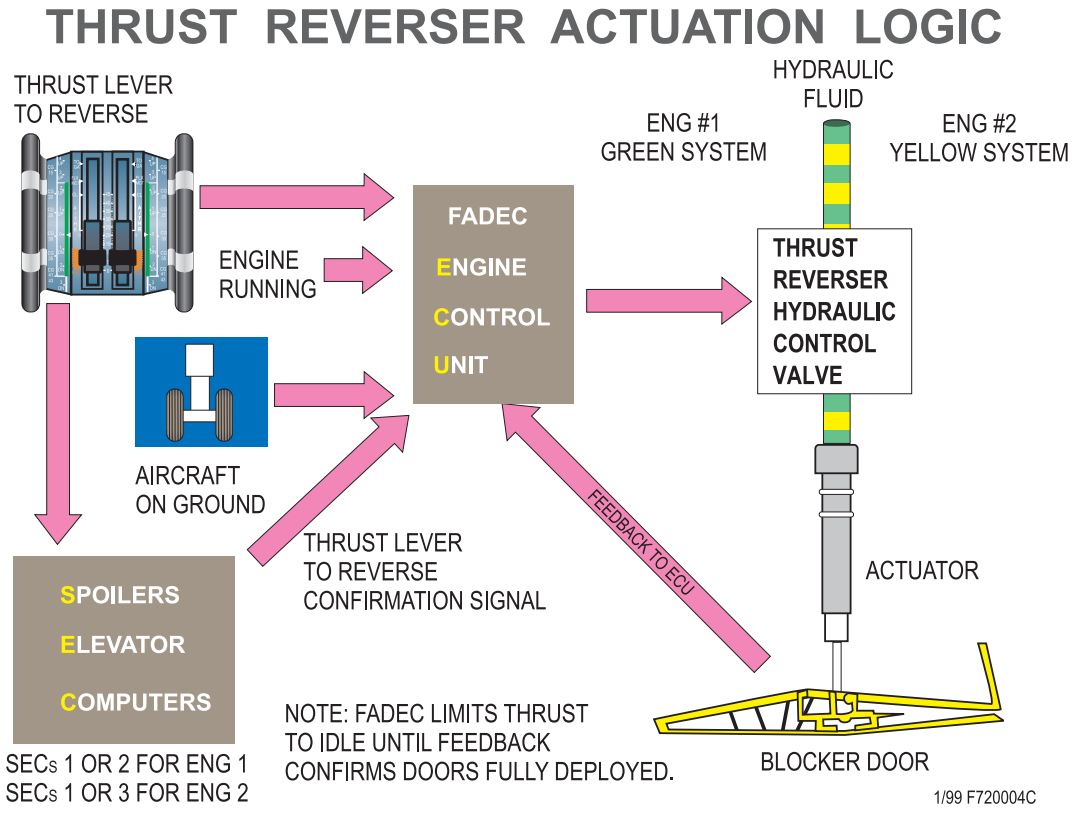
Reverse Thrust

Description

The pilot selects reverse thrust by raising the reverse thrust levers (on the front of the thrust levers), which allow the thrust levers to be retarded into the reverse range. There are four blocker doors on each engine. Each set of blocker doors is actuated by the hydraulic system corresponding to that engine's hydraulic pump.



The FADEC for each engine controls reverse thrust independently. Total actuation time for reversers should be less than two seconds. Only fan air is reversed on the engine. The FADEC limits reverse thrust for that engine to idle regardless of thrust lever position until all blocker doors indicate open. Reverse thrust deployment requires a reverse thrust lever command, both main gear must indicate on the ground, and the engine must be running.



Reverse Thrust (continued)

Description
(Continued)

Note: The selection of reverse thrust will also deploy the ground spoilers (if not already deployed automatically). The selection of reverse thrust on at least one engine is required for partial spoiler extension to function (refer to chapter 27, Flight Controls for more details).

Reverse Failures

The failure of the associated engine or hydraulic system will cause that engine reverser to fail.

Pilot reverse commands are processed by the SECs (as shown on the preceding graphic). Multiple SEC failures will result in the loss of one or both reversers.

Idle Control

Description

The FADEC has three idle modes: modulated idle, reverse idle, and approach idle.

Modulated Idle

Modulated idle (or “ground idle”) is selected whenever the aircraft is on the ground (provided reverse thrust is not selected), and while airborne with the slats retracted. Idle RPM depends on bleed system demand, oil temperature, and Mach number.

Reverse Idle

Reverse idle is selected when the thrust lever(s) is in the REV IDLE position, and is slightly higher than the modulated idle.

Approach Idle

Approach idle is designed to allow the engines to accelerate rapidly from idle to TOGA thrust, and is automatically selected whenever the slats are extended.

Approach idle results in approximately 4-8% higher N_1 than modulated idle, (depending on ambient conditions).

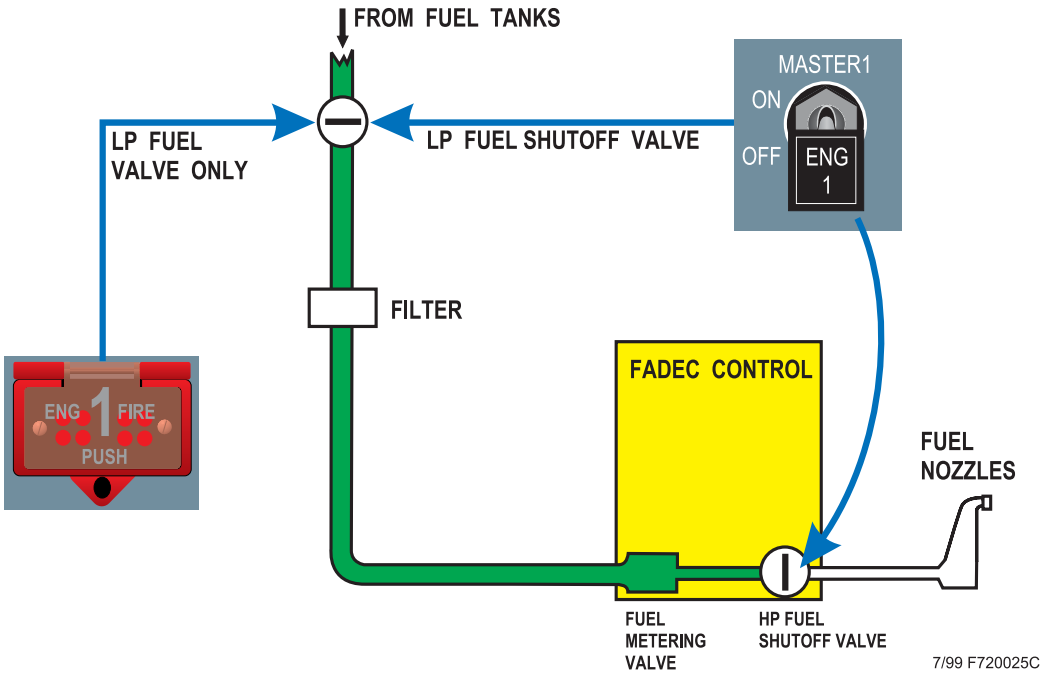
The actual thrust increase at approach idle is small; however, the improvement in acceleration time from idle to TOGA is significant.

Note: A number of system or sensor failures may result in one or both engines being limited to approach idle, resulting in an ECAM STATUS page “ENG 1 (2) APPR IDLE ONLY” message. No significant changes in aircraft handling will be noticed during approach or landing, as the thrust difference is minor.

Fuel System

Description

Fuel is pumped from the fuel tanks through the Low Pressure (LP) fuel shutoff valve. The fuel is filtered and the pressure increased by the engine driven fuel pumps up to the High Pressure (HP) fuel shutoff valve. The FADEC controls and meters the flow of fuel through the engine for thrust control, engine oil cooling, and engine driven Integrated Drive Generators (IDG) cooling. The engine fuel system is shown below.

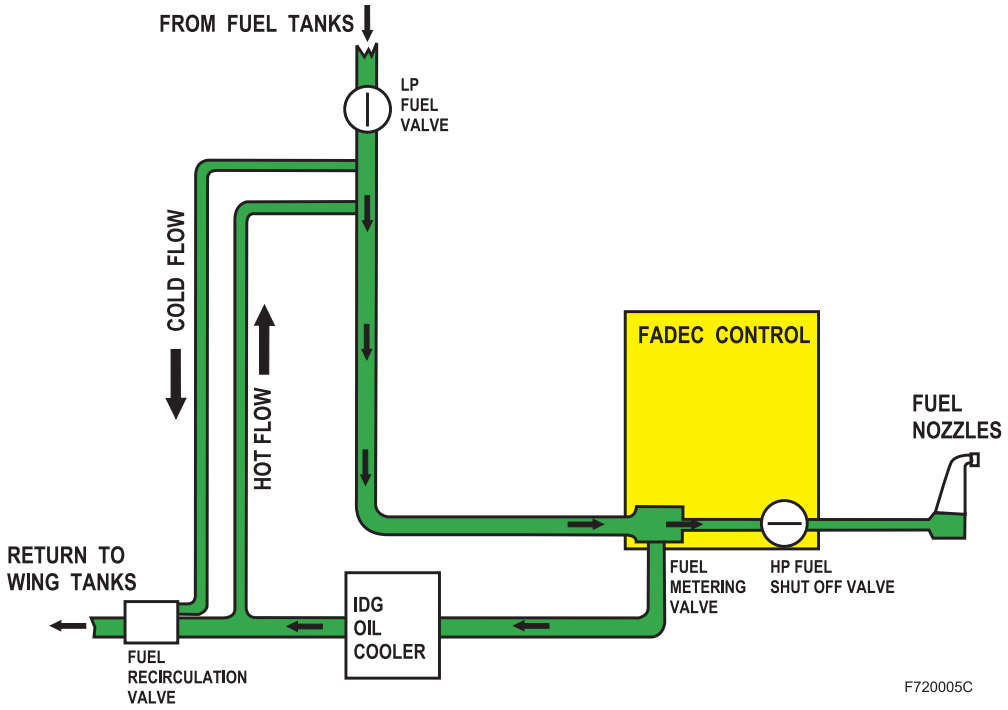


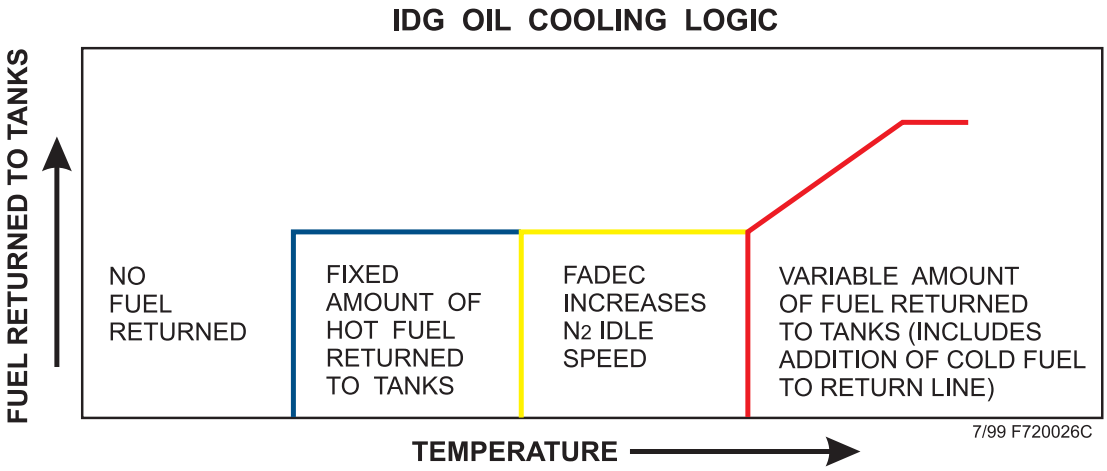
Fuel System (continued)

IDG Recirculation

Fuel is used to cool the IDG oil supply. At low power settings, the IDG workload increases and more fuel is required for cooling. The FADEC controls the recirculation valve which can return some of this hot fuel to the wing fuel tank after IDG cooling.

Each engine recirculation valve operates independently. This may result in a fuel imbalance or overfill condition when fuel is being drawn from the center tank and then returned to the wing tank due to IDG cooling demands. This will cause the center tank pumps to shut off temporarily to allow the wing tanks to burn down, preventing an overfill. The IDG cooling system is shown below.

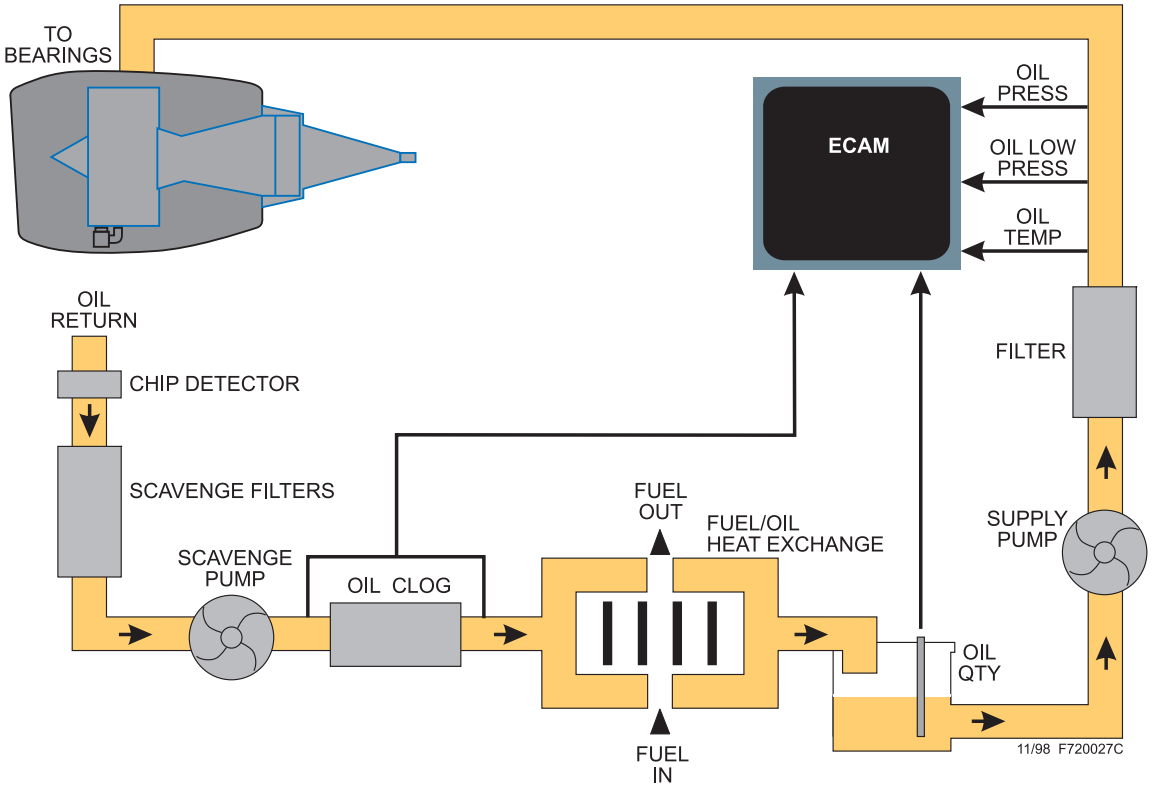




Oil System

Description

Oil is supplied to the engines for cooling and lubrication. Fuel is used to cool the oil supply. ECAM cautions are generated when the oil temperature or pressure exceeds limits, or when the oil filter becomes clogged. The engine oil system is shown below.



Air Bleed System

Description

Bleed air from an intermediate pressure (IP) or high pressure (HP) compressor stage provides air for the entire pneumatic system, including wing anti-icing, air conditioning, and pressurization. Only one source (HP or IP) is used at any time. The engine bleed valve regulates the pressure of the air entering the pneumatic system. Engine fan air is ducted to a precooler to cool engine bleed air. The engine bleed system is described in detail in chapter 36, Pneumatics.

Each engine provides bleed air for engine nacelle anti-ice from a separate source, totally independent of the pneumatic system air bleeds. Whenever the engine anti-ice is selected ON, the N_1 limit for that engine is reduced and the idle N_1 increases. If electrical power fails, the engine anti-ice valves open automatically. The engine anti-icing system is described in detail in chapter 30, Ice and Rain.

Ignition System

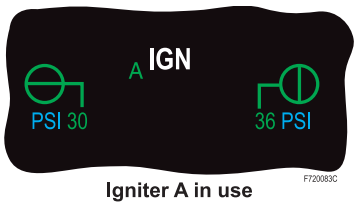
Description

Each engine's ignition system consists of two igniter plugs located in the engine's combustion chamber. Designated as igniter plug A and B, they are controlled and monitored by the engine's FADEC. Each engine's ignition system can be controlled automatically or manually.

Note: Because only igniter plug A of each engine is capable of being powered when in the Emergency Electrical Configuration, igniter plug A must be operational for all flights per the MDM.

Automatic Ignition Control

When performing an automatic ground start, FADEC will select which igniter plug to use and, activate ignition when the N_2 RPM reaches 16%. The FADEC alternates igniter selection with each successive start. The selected igniter (A or B) is displayed on the ECAM Engine page. The igniters automatically de-energize when the N_2 RPM reaches 50%.



Igniter A in use

In addition, FADEC will automatically activate continuous ignition (both igniters) under the following conditions:

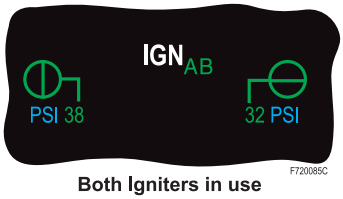
- when engine anti-ice is selected ON,
- when a delayed engine start is sensed,
- when the Engine Interface Unit (EIU) fails,
- when an engine flameout is sensed.

When continuous ignition has been activated, IGNITION appears in the ECAM memo section.

Continuous Ignition Acticated

Manual Ignition Control

When performing a manual engine start, FADEC will activate ignition using both igniters when the Engine Master Switch is placed to ON. Both A and B appears on the ECAM Engine page. The igniters automatically de-energize when the N_2 RPM reaches 50%.



Both Igniters in use

With an operating engine, continuous ignition can be manually selected by rotating the ENG MODE selector to IGN/START or by activating Engine Anti-Ice.

Note: Following an engine start, the ENG MODE selector must be reset to NORM and then back to IGN/START in order to activate continuous ignition.

Starting System

Description

Each engine's starting system, controlled and monitored by its FADEC, allows for several types of engine starts, to include: Automatic Ground Start, Manual Start and In-flight Relight.

Note: Regardless of which type of start is attempted, the pilot always has manual start abort authority by placing the ENG MASTER Switch to OFF.

Automatic Ground Start

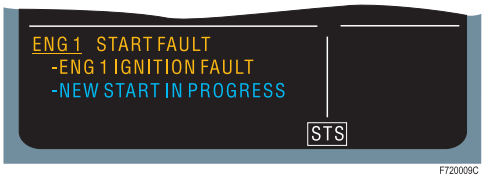
Automatic ground start is the normal method of starting the engines. Initiated by placing the ENG MASTER SW to ON, the FADEC controls and monitors the sequencing of:

- start valve opening and closing,
- ignition activation and termination (normally one igniter), and
- fuel valve opening.

In addition, FADEC will provide N_1, N_2, and EGT exceedance protection.

In the event FADEC senses a start abnormality, it will automatically stop fuel flow and ignition but will keep the engine's starter engaged while it attempts to rectify the malfunction. Once FADEC has corrected the malfunction, it will once again activate ignition and fuel flow.

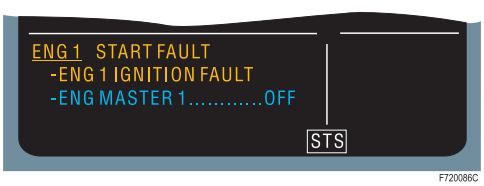
An ECAM MEMO message (NEW START IN PROGRESS) is displayed informing the pilot that FADEC is attempting to rectify a start malfunction. No pilot action is required. The FADEC can perform up to four automatic start attempts.



No Pilot Action Required

Caution: *FADEC cannot identify or correct for a hung start or tail pipe fire, nor will there be any ECAM messages associated with either malfunction. Therefore, the start must be manually aborted by placing the Engine Master Switch to OFF.*

In the event FADEC cannot correct a sensed start malfunction, it will automatically abort the start to include the closure of the start valve. An ECAM message ENG MASTER SW OFF appears and a FAULT (amber) light illuminates on the Engine panel. The pilot will place the Engine Master Switch to the OFF position.



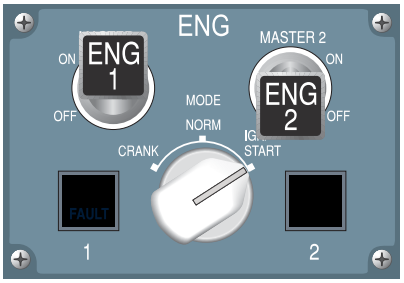
Pilot Action Required

Note: Placing the ENG Master Switch to OFF completes one start cycle.

Starting System (continued)

Automatic Ground Start (continued)

An automatic ground start is initiated by first placing the ENG MODE selector to IGN /START and then placing the respective ENG MASTER Switch to ON.



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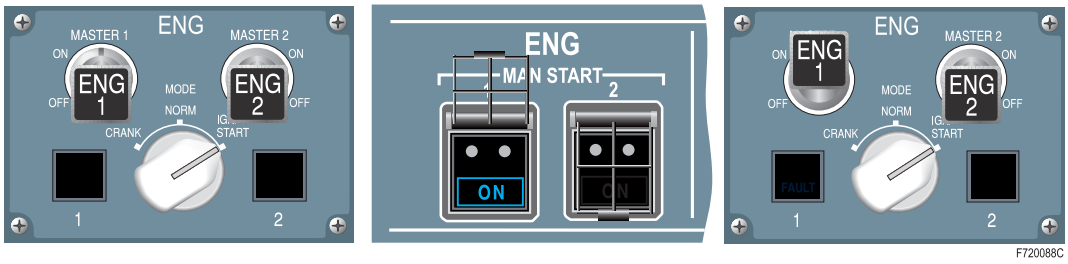
Manual Start

When FADEC is incapable of performing an automatic ground start, a manual start can be performed. A manual start differs from an automatic ground start in that it is initiated by the pilot performing the following:

- command the start valve open by selecting ON with the respective ENG MAN START pb, and
- activate ignition (both igniters) and fuel flow by placing the ENG Master SW to ON.



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The start valve will automatically close and ignition will be stopped automatically when N_2 RPM has reached 50%.

Note: FADEC will command the starter valve close but the ENG MAN START pb will remain illuminated ON until it is deselected lights out.

Other than EGT exceedance protection below 50% N_2 during a manual start, FADEC does not have abort authority, it will only passively monitor the start and display sensed abnormalities on the ECAM memo section. Pilot action will be required should a malfunction occur.

Note: FADEC will continue to provide N1 and N_2 exceedance protection but, unlike an automatic ground start, will *only* provide EGT exceedance protection when N_2 is below 50%.

Starting System (continued)

In Flight Relight

In flight, when a FADEC senses that its engine has flamed out, it will perform an automatic restart, or the pilot can perform a manual restart of the engine. Both methods are referred to as an In Flight Relight.

Note: During an in flight relight, performed either automatically or manually, FADEC does not have start abort authority or provide EGT exceedance protection. It will however provide N_1 and N_2 exceedance protection.

Automatic In Flight Relight:

When FADEC senses that its respective engine's N_2 RPM has decreased below a preset limit, an automatic relight logic is activated. The FADEC will automatically activate continuous ignition and adjust fuel flow in an effort to restart the engine.

Manual In Flight Relight:

In the event FADEC was unsuccessful in performing an automatic relight, a manual relight can be performed utilizing the instructions located in the QRH, Engine Relight procedures.

Caution: *Do not attempt a relight of a damaged engine.*

Following the QRH procedure, pneumatic bleed air from the operating engine will be made available to the flamed out engine's starter. If FADEC determines that the engine's N_2 windmill speed is insufficient for start, it will automatically command the engine's starter control valve open.

Note: The ECAM system will *not* provide instructions on how to perform a manual in flight relight. The flight crew must utilize the QRH Engine Relight Procedures.

Manual Start Valve Operation

On the ground, should an engine's starter control valve fail to open, maintenance personnel have the capability to manually open the engine's starter control valve. The valve is accessed through a panel located on the right side of each engine's cowling.

Refer to the Volume 1, Supplementary procedures for specific procedures.

External Air/Crossbleed Starts

In the event APU air is unavailable, the first engine may be started using an external air source. Once the first engine has been started, the second engine will be started using cross bleed air from the operating engine. Refer to the Volume 1, Supplementary procedures for specific procedures.

Caution: *Do not allow engine bleed air and external air to pressurize the pneumatic manifold at the same time.*

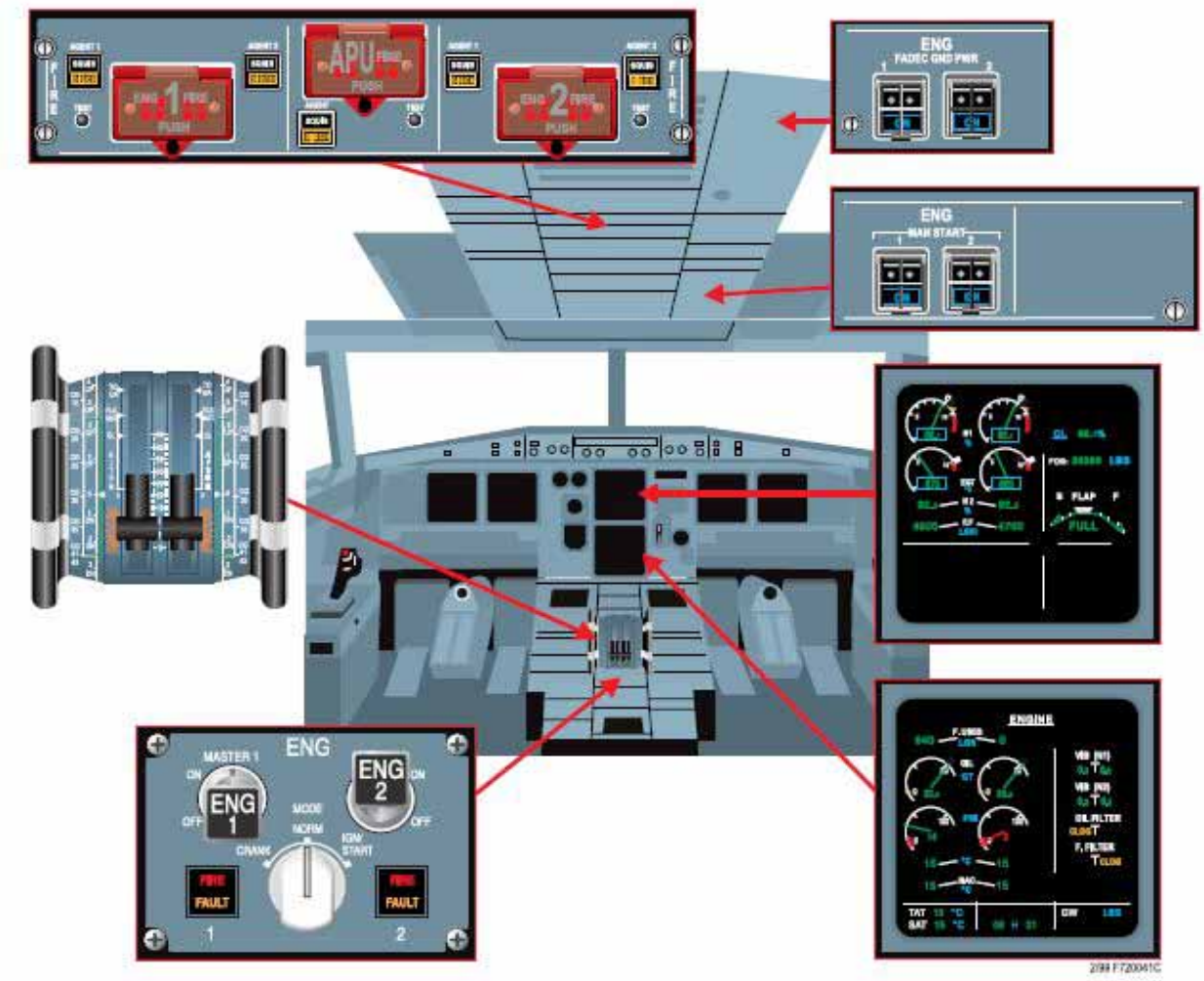
Controls and Indicators

Location of Controls and Indicators

Introduction

Engine controls and indicators are located on the:

- pedestal,
- Multifunction Control and Display Units (MCDUs),
- overhead panel,
- Flight Control Unit (FCU),
- Engine/Warning Display (E/WD), and
- System Display (SD) ENGINE and CRUISE pages.



Thrust Levers

Description

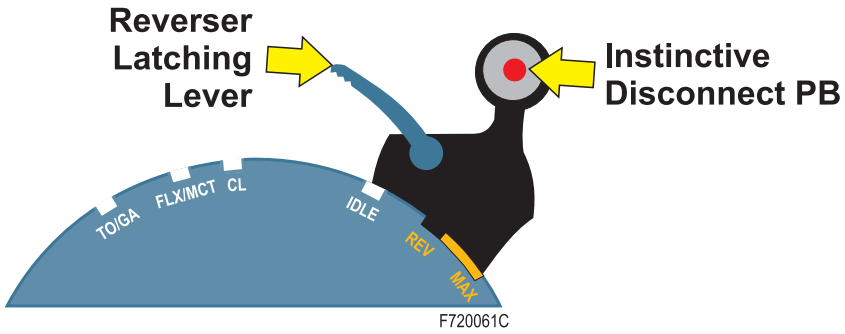
Engine thrust output corresponds directly to the position of the associated thrust lever. Regardless of the status or operating mode of the Autothrust system, thrust lever position limits the thrust output of its associated engine.

Detents located along the thrust lever quadrant correspond to autothrust operating modes. (Refer to Chap 22 Autoflight, for a complete description of the Autothrust system).

A Reverser Latching Lever, located on each thrust lever, when raised permits the respective thrust lever to be moved into the reverse thrust range.

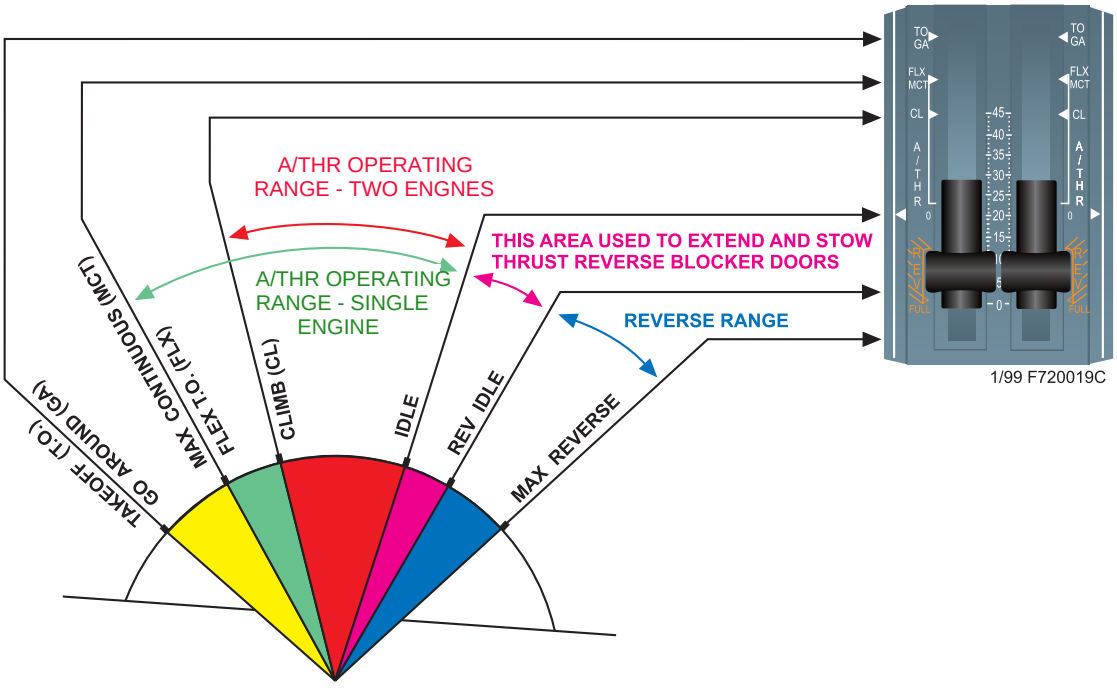
Each thrust lever is equipped with an Instinctive Disconnect pb. When either is selected once, the engaged Autothrust system is commanded off.

Caution: *If either Instinctive Disconnect pb is pressed and held for a continuos 15 seconds, the Autothrust system is deactivated for the remainder of the flight. All autothrust functions, to include Alpha Floor are lost.*



Thrust Lever Detent Positions

The thrust levers have six detent positions.



Thrust Levers (continued)

Thrust Lever Positions (continued)

With autothrust off, placing the thrust lever(s) in a detent selects these thrust levels:

TOGA Stop

Maximum thrust is called “Take Off and Go-Around (TOGA) thrust.” It is selected with the thrust lever(s) at the full forward stop. The FADEC always prevents the engine from exceeding RPM limits. However, the FADEC does not prevent the engine from exceeding EGT limits.

FLX/MCT Detent

Reduced takeoff, or FLEX (FLX) thrust is selected when the thrust levers are placed in this detent on the ground with a FLEX temperature entered on the MCDU PERF TAKEOFF page. FLEX thrust continues until the thrust levers are moved from this detent.

Caution: *If the pilot places the thrust levers in this detent during takeoff, and a FLEX temperature was not entered on the MCDU PERF TAKEOFF page, the FADEC will command MCT thrust. This will also result in a master caution and an ECAM FLEX TEMP NOT SET message.*

Maximum Continuous Thrust (MCT) is selected when the thrust lever(s) are in this detent (except during a FLEX takeoff).

Note: If MCT thrust is desired following a FLEX takeoff, the thrust lever(s) must be moved to TOGA or CLB and then placed back into the detent to command MCT thrust.

CL Detent

Climb (CL) thrust is selected with the thrust levers in this detent.

IDLE Stop

Idle thrust is selected with the thrust levers in this detent.

Reverse Idle (REV)

The reverser latching levers are located on the front of each thrust lever. The pilot commands reverse idle thrust by pulling up on the reverse thrust levers.

Note: On landing, the selection of reverse thrust also deploys the ground spoilers, if not previously deployed automatically (refer to chapter 27, flight controls).

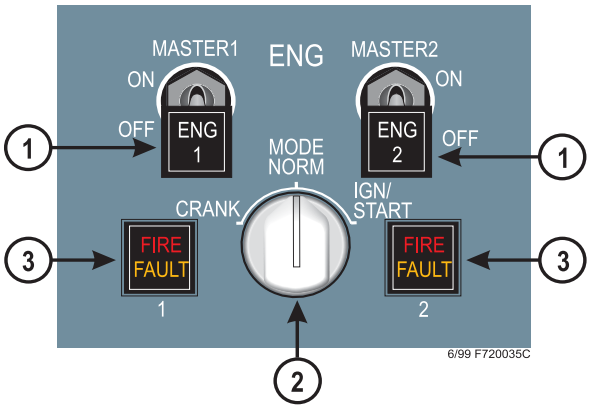
Maximum Reverse MREV

Maximum reverse (MREV) is commanded at the full aft reverse detent. The FADEC prevents the engine from exceeding RPM limits.

Pedestal Engine Panel

Description

The engine control panel is located on the pedestal and includes the primary controls for starting and shutting down the engines. The engine control panel includes the ENG MASTER switches, the ENG MODE selector, and a FIRE/FAULT light for each engine.



(1) ENG MASTER Switches

The ENG MASTER switches electronically control the fuel valves and initiate the engine starting process.

When selected OFF, the engine master switch closes both the Low Pressure (LP) and the High Pressure (HP) fuel shutoff valves and is the most direct means of shutting down the engine.

Automatic Engine Start

During an automatic ground start, (with the ENG MODE selector at IGN/START), selecting an ENG MASTER switch to ON results in the following:

- the LP fuel valve opens,
- the corresponding N_2 is highlighted on the E/WD,
- the EGT limit (tic mark) decreases to the start limit, and
- the FADEC initiates an automatic start by opening the start valve. It will initiate ignition and open the HP fuel valve when appropriate.

Selecting the ENG MASTER switch to OFF closes both fuel valves, the start valve, and terminates the start.

Manual Engine Start

During a manual engine start, (with the ENG MODE selector at IGN/START and the ENG MAN START pb ON) selecting an ENG MASTER switch to ON results in the following:

- both fuel valves (LP and HP) open, and
- ignition is initiated using both igniters.

Selecting the ENG MASTER switch to “OFF” closes both fuel valves and terminates the start.

Pedestal Engine Panel (continued)

(2) ENG MODE Selector

The ENG MODE selector is used for selecting continuous ignition, engine starting, and dry cranking.

NORM

NORM provides automatic continuous ignition when the engine is running and:

- engine anti-ice is selected on,
- the EIU fails, or
- the FADEC detects an engine flameout.

IGN/START

When IGN/START is selected prior to engine start, the System Display ENGINE page is automatically displayed with the start valve information. The FADEC will be connected to the aircraft electrical system, and an automatic start will begin when the ENG MASTER switch is selected ON.

Note: This action also closes the pack valves. If an ENG MASTER switch or MANUAL START pb is not selected ON within 30 seconds, the pack valves automatically open. Therefore, to prevent unnecessary pack valve cycles, IGN/START should not be selected until immediately prior to engine start.

With the engine operating at or above idle, selecting IGN/START will activate continuous ignition.

Note: Following an engine start, the ENG MODE selector must be recycled to NORM and then back to IGN/START to activate continuous ignition.

Pedestal Engine Panel (continued)

ENG MODE Selector (continued)

CRANK

Dry cranking is performed by using the ENG MODE selector and the MAN ENG START pb.

The CRANK position allows the engine to be dry cranked (with the ENG MAN START pb selected ON). The CRANK position prevents supply ignition and fuel.

The ENG MASTER switch is not used during dry cranking.

(3) FIRE/FAULT Lights

The FIRE/FAULT lights have two possible indications.

FIRE Light

The fire light on the engine control panel illuminates red if an engine fire warning has been detected. This light is a repeater indication of the warning light in the ENG FIRE pb on the overhead panel.

FAULT Light

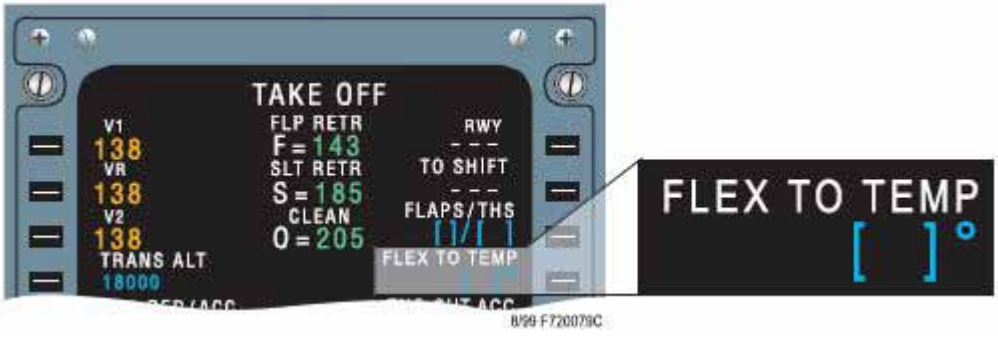
The engine FAULT light illuminates amber if:

- an automatic engine start is aborted, or
- a disagreement exists between the HP fuel valve and its commanded position.

MCDU

Setting FLEX Temperature

A reduced thrust takeoff (e.g., FLEX) assumed temperature is set on the MCDU performance TAKEOFF page.



Overhead Panel

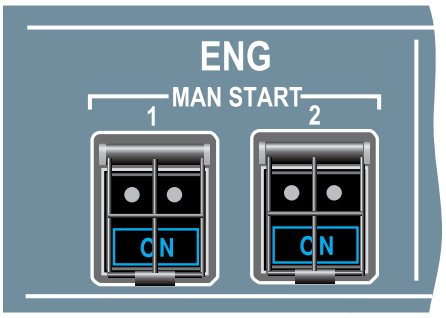
General

The overhead panel has three controls related to the engines - the ENG MAN START pbs, the FADEC GND PWR pbs, and the FIRE pbs.

ENG MAN START pb

The ENG MAN START pbs allow the pilot to manually control the engine start valves. When selected to:

ON [pb in]: The selected engine start valve opens (provided the ENG MODE selector is at CRANK or IGN/START) and the ON light illuminates blue.



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Note: When the manually started engine N_2 reaches 50%, the engine start valve will automatically close. However, the pb will remain in and illuminated until deselected manually. Deselecting this pb prior to 50% N_2 has no effect if the ENG MASTER switch is ON.

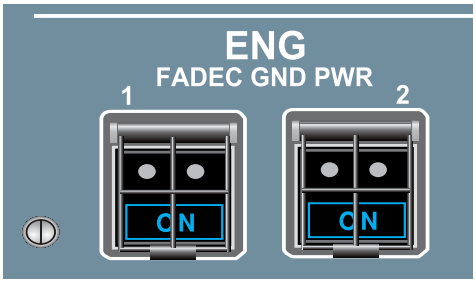
Lights out [pb out]:

- if the ENG MODE selector is in CRANK, the start valve closes and the ON light extinguishes,
- if the ENG MODE selector is in IGN/START and the ENG MASTER is OFF (a start is not in progress), the start valve closes and the ON light extinguishes, or
- if the ENG MODE selector is in IGN/START and the ENG MASTER is ON (a start is in progress), the start valve is controlled by the FADEC and is latched open, and the light remains on. Once FADEC closes the start valve, deselection of the ENG MAN START pb causes the ON light to extinguish. Therefore, to abort a manual start, the ENG MASTER switch must be used.

ENG FADEC GND PWR pbs

The ENG FADEC GND PWR pbs are on the far aft overhead maintenance panel.

These pbs are used by maintenance to power the FADECs on the ground without moving the mode selector out of the NORM position.



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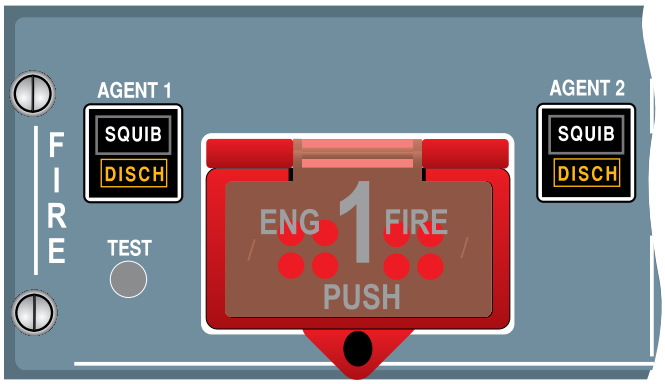
Overhead Panel (continued)

ENG FIRE pbs

There is one engine fire pb for each engine. Releasing an ENG FIRE pb also removes aircraft electrical power from the engine FADEC.



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The ENG FIRE pbs provide an alternate means of engine shutdown in the event of the failure of an engine master switch.

Note: If the engine is shut down using only the engine fire pb, only the LP fuel valve closes. It may take up to one minute (at idle) for the engine to stop running as fuel is burned between the low pressure fuel valve and the engine.

Refer to chapter 26, Fire Protection, for more information on these pbs.

FCU A/THR pb

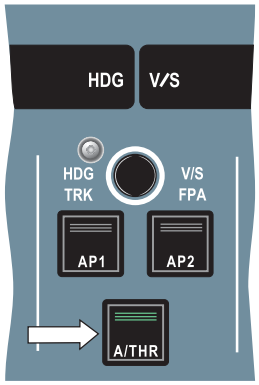
Purpose

The A/THR pb on the FCU is used to manually arm the autothrust system. The A/THR pb can be used to disconnect A/THR however, this method results in false A/THR failure indications. The preferred method to disconnect A/THR is to use either instinctive disconnect pb on the thrust levers.

The pb illuminates green when autothrust is armed or active.

To determine if autothrust is active, the FMA must be referenced.

When A/THR is not armed or active, the FCU A/THR pb is not illuminated.



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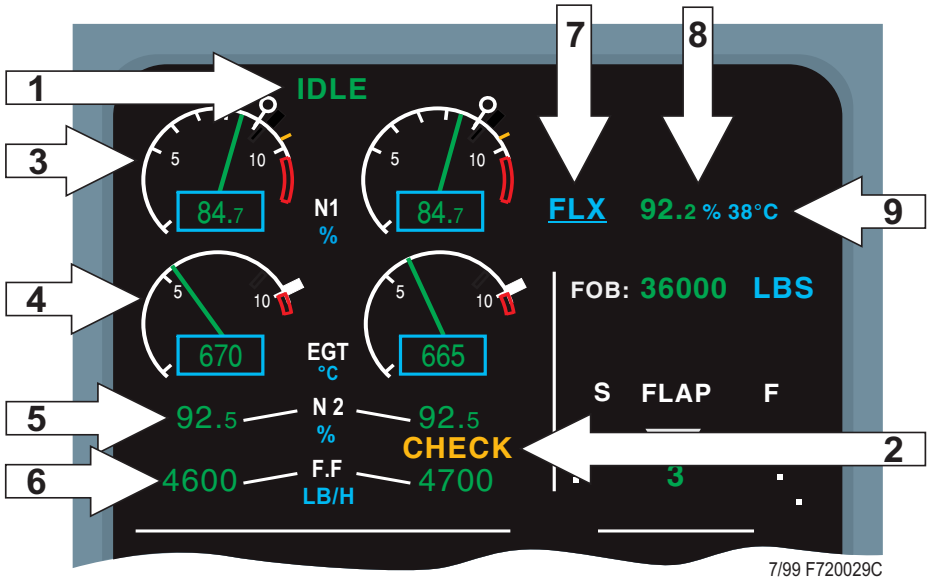
Refer to chapter 22, Autothrust, for a complete discussion of the autothrust system.

Engine Indications on E/WD

Engine Indications

Primary engine indications are displayed on the Engine/Warning Display (E/WD).



(1) IDLE

IDLE is displayed whenever the engines are at idle. The indication flashes for a short period, and then remains displayed steady.

(2) CHECK

If there is a discrepancy between the actual N_1, N_2, EGT, or fuel flow values and the corresponding displayed values, an amber CHECK message is displayed below the affected parameter's indication.

(3) N_1

RPM of the low speed turbine. This is the primary thrust indication of the engine.

(4) EGT

Exhaust Gas Temperature indication.

(5) N_2

RPM of the high speed turbine.

(6) FUEL FLOW

The amount of fuel metering into the engine.

(7) THRUST LIMIT MODE

The current mode as determined by the thrust lever position and operational phase.

(8) N_1 RATING LIMIT

The N_1 limit corresponding to the current thrust limit mode.

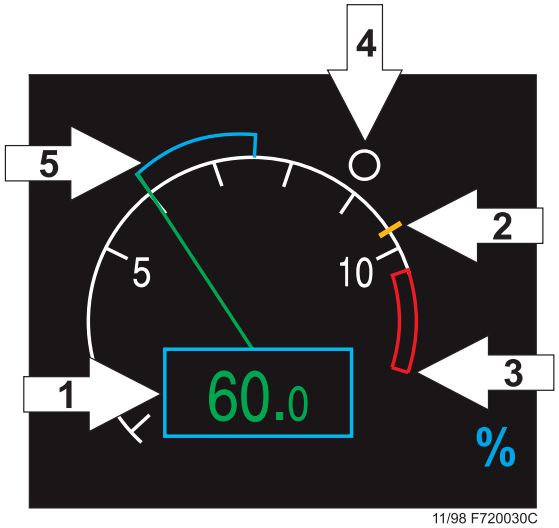
(9) FLEX TEMP

The assumed temperature to reach the FLEX N_1 limit (displayed only with FLX thrust limit mode).

Engine Indications on E/WD (continued)

N_1 Indication

The engine N_1 indications are shown below:



(1) RPM

The analog and digital N_1 indications normally appear in green, and represent current engine fan speed. This is the pilot's primary indication of engine thrust.
The needle pulses amber when the N_1 speed reaches the cautionary range.
The needle and numeric value pulse red when N_1 exceeds the maximum limit.

If both of the N_1 sensors on the same engine fail, the last digit shown will be dashed in amber.

(2) TICK MARK

An amber tick mark represents the FADEC computed maximum N_1 for the current ambient conditions.

(3) RED ARC

The beginning of the red arc represents the maximum permissible N_1.
If the N_1 exceeds this value, a red tick mark appears and remains in view, representing the highest N_1 attained.

The red tick mark is normally cleared by maintenance.

(4) WHITE CIRCLE

The white circle indicates the position of the thrust lever.

(5) BLUE ARC

The transient blue arc shows the difference between the actual N_1 and the thrust commanded by the Autothrust system. It is not displayed with the autothrust off.

Engine Indications on E/WD (continued)

Reverse Thrust

The position of the engine thrust reversers are indicated on the N_1 indicator as follows:

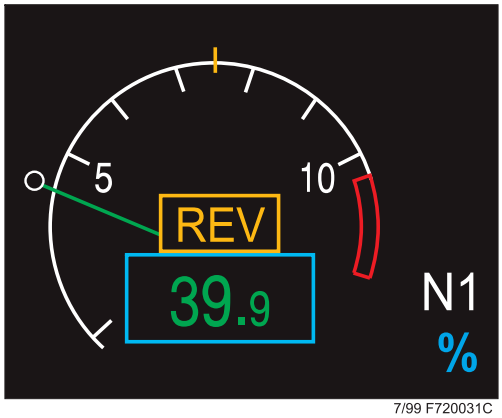
Reverser In Transit

Engine reverse thrust depictions appear when one or more of the blocker doors indicate unstowed or unlocked.

The REV indication is amber until all of the blocker doors on that engine reach the commanded position.

If unlocked in flight, this indication will flash momentarily and then remain steady.

The REV indication is removed when all blocker doors are closed.



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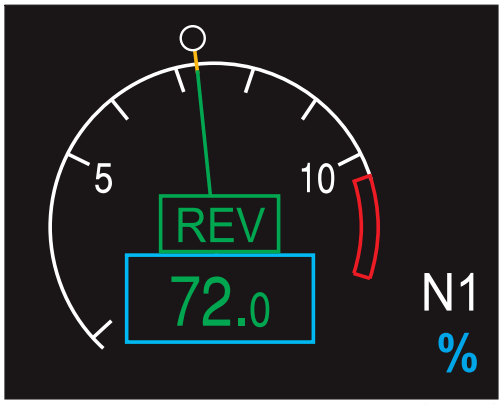
Reverser Fully Deployed

The FADEC limits reverse thrust to idle reverse until all of the blocker doors on the engine indicate fully deployed.

At this time the “REV” depiction on the N_1 indicator changes to green, and the pilot can modulate reverse thrust from idle reverse to maximum reverse.

The amber tic mark indicates the maximum allowable reverse thrust.



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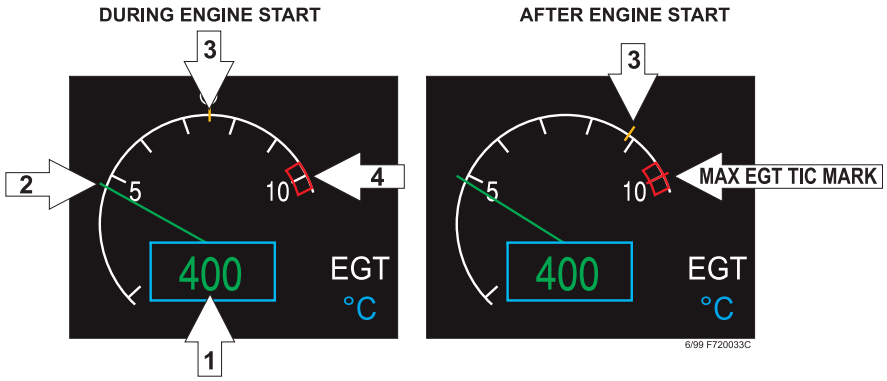
Engine Indications on E/WD (continued)

EGT Indication

EGT limits for all CFM-56 engine types (A-1, A-3, A-4, and A-5) are presented in an identical manner, and use the same “numeric” limits. The actual engine EGTs are artificially adjusted so that the same numeric values are displayed, regardless of the engine type.



1 Digital EGT Indication

Digital EGT indications normally appear in green. The indications pulse in red when the EGT exceeds the maximum limit of 890°C, along with the EGT OVERLIMIT ECAM message.

On all A320s and some A319s, a modification to this system’s logic will permit the engine to operate between 890° and 900°C for 20 seconds. During this time EGT indications will latch at 889°C. This is referred to as Transient Overshoot. Following the 20 second delay should temperatures remain within the exceeded values or should the temperature exceed 900°C, all warning indications return to include actual temperature.

Note: The ECAM EGT OVERLIMIT message is inhibited during takeoff and landing.

2 EGT Needle

The EGT needle appears in green in the normal range.

The needle will pulse in amber whenever the EGT exceeds the normal limit (855°C) except:

- when takeoff thrust is selected,
- with maximum reverse thrust selected, or
- when alpha floor is active.

The needle will pulse in red when the EGT exceeds the maximum limit (890°C).

3 Maximum EGT Tick Mark

An amber tick mark is displayed at the top of the normal range when the engine is operating. The tic mark is not displayed during takeoff.

During engine start, the tick mark moves to the starting limit (725°C). Once the start is complete, the tick mark moves to the normal MCT limit.

4 Red Arc

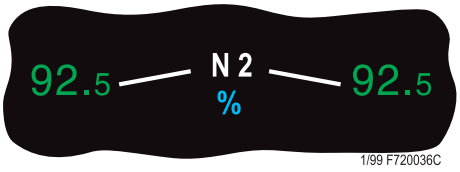
The beginning of the red arc represents the maximum permissible EGT. If the EGT exceeds this value, a red tick mark appears and remains in view, representing the highest EGT attained. The red tick mark is normally cleared by maintenance.

Engine Indications on E/WD (continued)

N_2 Indications

Normal Indications

The digital N_2 indication is normally displayed in green.



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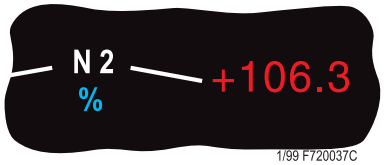
N_2 Limit Exceeded

If N_2 exceeds a predetermined limit, the indication becomes red and a red cross appears next to the digital indication.



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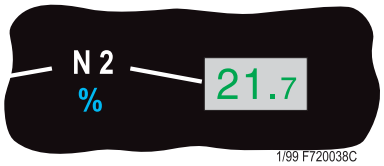
Start Indication

During engine start, the N_2 indication of the engine being started is highlighted with a box and a grey background.



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Failed Sensors

If both engine N_2 sensors on the same engine fail, the last digit shown will be dashed in amber. The indication is usable but of degraded accuracy.

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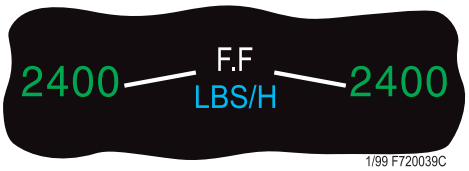
Fuel Flow Indication

Fuel Flow is displayed in green.



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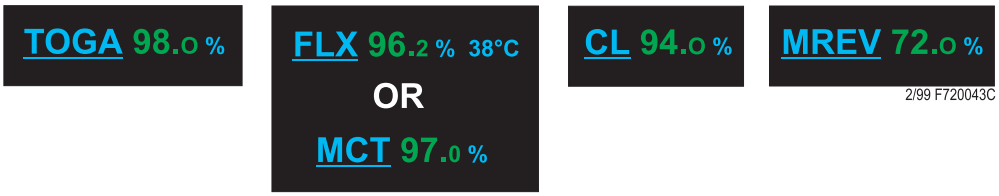
Engine Indications on E/WD (continued)

Thrust Limit Mode & N_1 Rating Limit

The thrust limit mode is displayed in blue followed by the corresponding N_1 rating limit in green. The N_1 rating limit is computed by the FADEC based on current ambient conditions (temp & pressure altitude).



If the FLX mode is displayed it will be shown with the FLEX temp (in blue) that the pilot entered on the MCDU PERF TAKEOFF page.

The thrust limit mode that is displayed depends on thrust lever position and the current operational phase. Prior to engine start TOGA, FLX, MCT, CL, or MREV modes may be displayed depending on thrust lever position. For example, if the thrust levers are in the idle detent or forward up to and including the climb detent, the CL thrust limit mode is displayed.

Once the engines are running with the aircraft on the ground, either the TOGA or FLX mode (if the pilot enters a FLEX temp in the MCDU) is displayed with the thrust levers at idle or forward, and MREV will be displayed with a thrust lever in reverse.

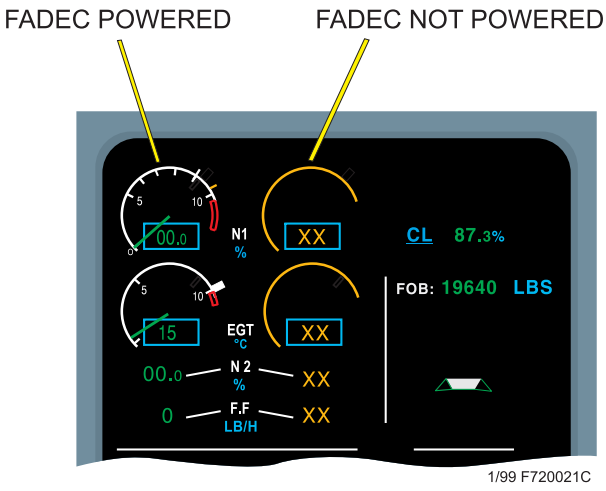
Once airborne, possible modes include TOGA, MCT, or CL, depending on thrust lever position. (FLX is displayed during the initial climb out after takeoff until the pilot moves the thrust levers out of the FLX/MCT detent.)

Note: The displayed thrust limit mode corresponds to the most forward thrust lever position.

FADEC Power Indications

The engine indications on the E/WD are displayed whenever the FADEC is supplied with electrical power.

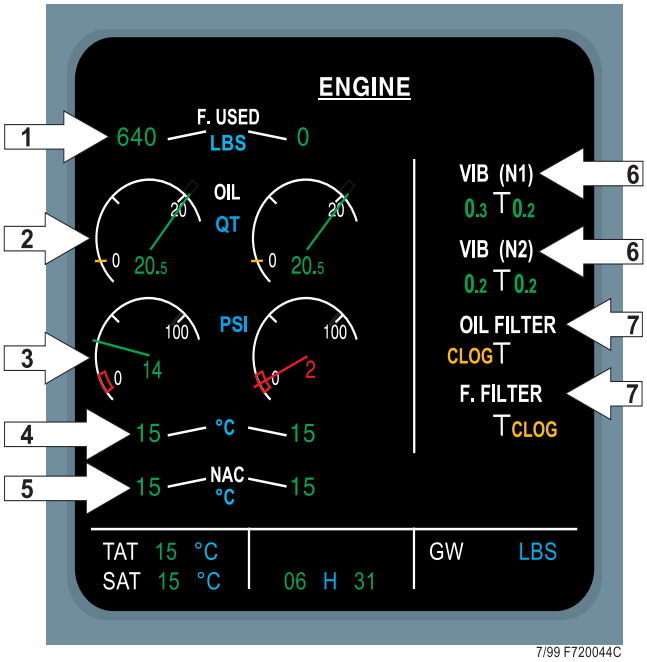
When the FADEC is not powered, engine indications on the E/WD are replaced by amber circles and XXs.



Engine Indications on the System Display ENGINE PAGE

Engine System Display Page

The ECAM ENGINE system display page is shown below:



(1) Fuel Used Indication

The fuel used depiction is digital and is displayed in green. The last value is frozen at engine shutdown and automatically resets to zero during the next engine start.

(2) Oil Quantity Indication

Oil quantity is displayed in green. The indication pulses when the oil quantity drops below a preset level.

Note: Oil quantity indications can decrease as much as six quarts during or after engine start.

(3) Oil Pressure Indication

Oil pressure is normally displayed in green. If the oil pressure drops below an advisory limit, or exceeds the upper limit, the indication pulses in green.

The indication becomes red if pressure drops below the minimum limit. An ECAM warning is also generated.

Note: An engine that has been shutdown in-flight may display zero oil pressure at low N_2 RPM. This does not necessarily indicate an oil system problem.

(4) Oil Temperature Indication

Oil temperature is normally displayed in green. The display pulses if the oil temperature exceeds a preset advisory limit.

The indication becomes amber if the oil temperature increases above a preset limit.

Engine Indications on the System Display ENGINE PAGE (continued)

(5) Nacelle Temperature Indication

The nacelle temperature indications are only displayed when the temperature exceeds a preset limit. A pulsing nacelle temperature may indicate an engine fire or an air bleed leak.

Refer to chapter 26, Fire Protection, for additional details.

Start Valve Indications

The start valve indications are displayed in the same position as the nacelle temperature indications. These indications are discussed in detail in the next section.

(6) Vibration Indications

The engine vibration indications are displayed in green. The N_1 and N_2 indications will pulse if vibrations exceed a preset advisory limit.

(7) Clogged Oil and Fuel Filters

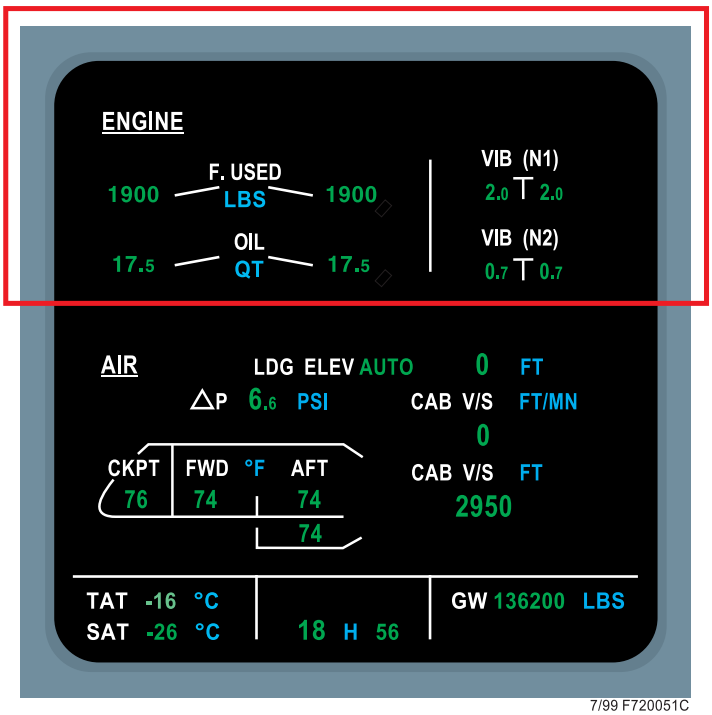
Indications of clogged oil and fuel filters are displayed on the ENGINE page only if the oil or fuel filter becomes clogged.

Cruise Page

Description

This page automatically appears when the landing gear is retracted if no other system display page has priority. Fuel used, oil quantity (digital only), and N_1 and N_2 vibration indications are displayed and repeat information from the ENGINE page.

If engine indications become advisory (pulsing green) or exceed a limit, the ENGINE page is automatically displayed.



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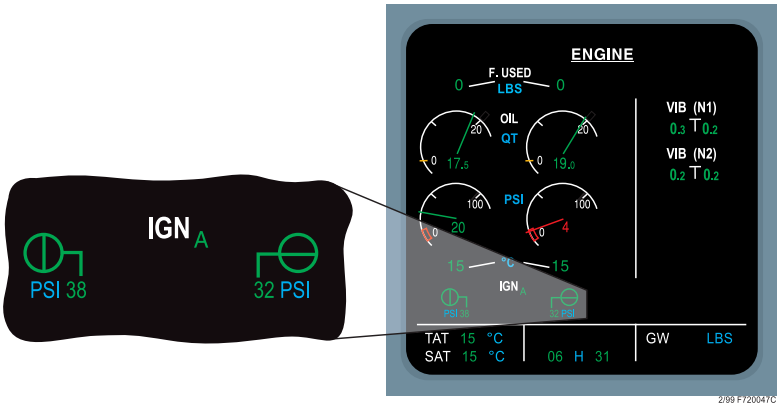
Engine Start Indications

Start Valve Indications

The start valve indications are displayed in the same position as the nacelle temperature indications. They are only displayed when an engine is not running, with the ENG MODE selector in the IGN/START or CRANK positions.



These indications are automatically removed when both engines are above idle, or if the ENG MODE selector is returned to NORM.

Note: The start valve indications will remain displayed after both engines are started only if a start valve malfunction has occurred.

Igniter Indication

The active igniter(s) is/are indicated in green by the letters A, B, or AB.

Start Valve Indication

The start valve indications are shown in green. A horizontal line (in line)represents an open valve, while a closed valve will be shown by a vertical line (crossline).

Starter Air Pressure Indication

The air pressure to the starter is normally green. The display turns amber if an overpressure condition exists, or if the pressure drops below a preset limit, as shown on the right in the graphic above.

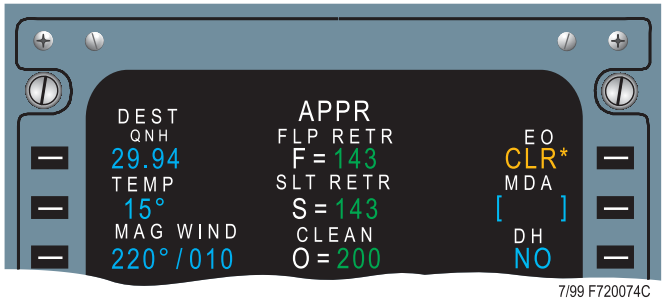
FMS Engine Failure Indications

Description

The FMS monitors the status of the engines when determining predicated aircraft performance. If one of the engines fail, the FMS reverts to a single engine status. The FMS considers an engine failed if:

- the engine master switch is off,
- the engine N_1 is below a preset limit, or
- one thrust lever is significantly retarded below the other.

When this occurs, an amber EO CLR prompt is displayed on the MCDU PROG and PERF pages.



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With the EO CLR prompt displayed:

- The flight guidance limits bank angle (refer to chapter 22, Autoflight),
- The autothrust active range increases from the CLB detent to the MCT detent (refer to chapter 22, Autoflight),
- The FMS provides single Long Range Cruise (LRC) altitude data on the MCDU PROG page (refer to chapter 34, Navigation, MCDU Operations), and
- The flight guidance NAV mode provides Engine Out (EO) SID steering if the data base has an EO SID and the aircraft has not flown beyond the point at which the EO SID and normal SID differ (refer to chapter 34, Navigation, MCDU Operations).

If the EO CLR prompt is selected, it disappears from the MCDU and the FMS returns to normal two engine displays and calculations.

Note: With the exception of LRC altitude, the FMS does not have a single engine performance data base.

Chapter 84: Miscellaneous

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Chapter 85: Warning Systems

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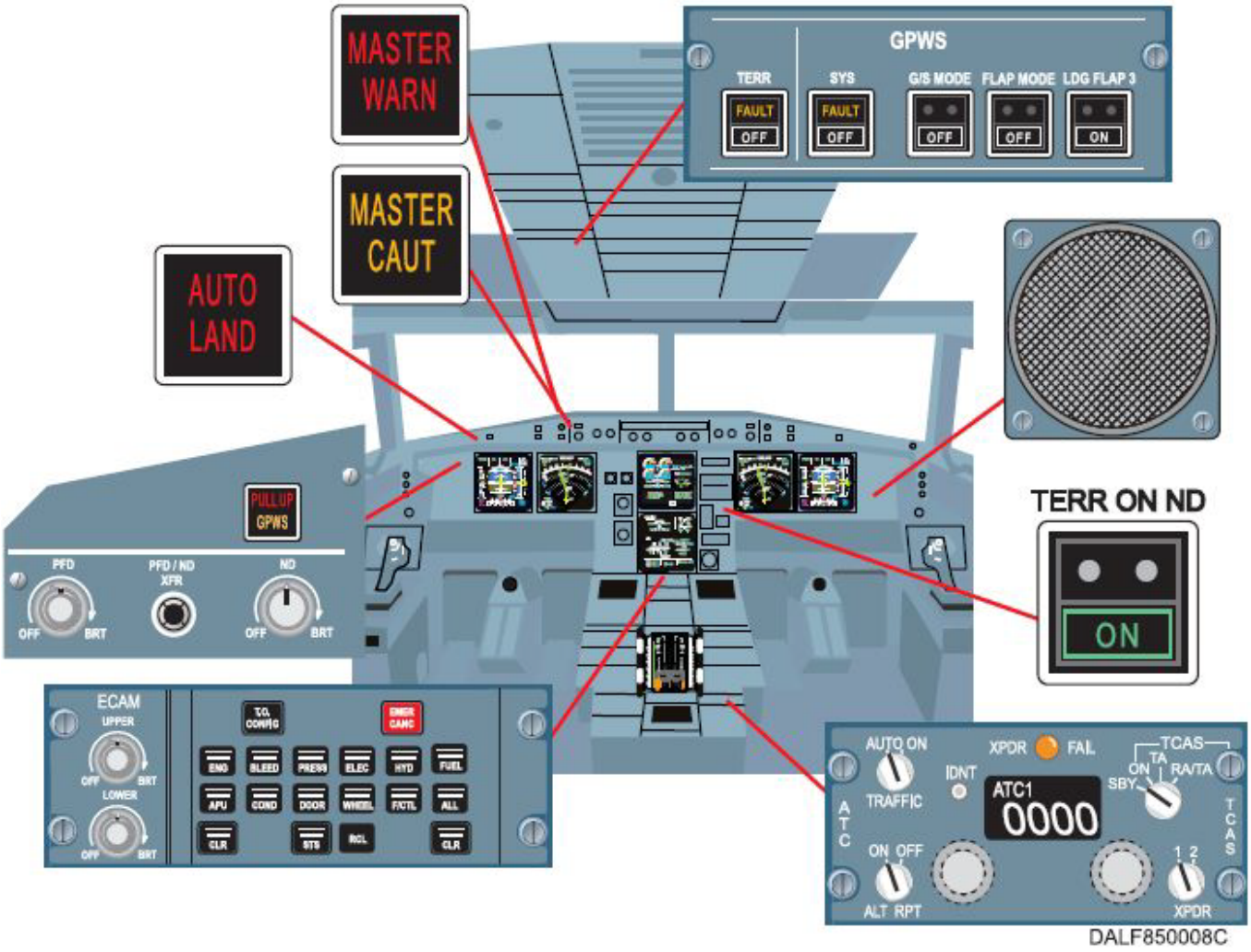
System Description

Location of Warning System Components

Location of Components

Components associated with the warning and caution systems are located throughout the cockpit. In addition, an external warning horn is located in the nose gear bay to provide a warning during certain ground failures.



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General Description

General

The Electronic Centralized Aircraft Monitor (ECAM) system provides warnings of aircraft system degradations and failures. Failures are automatically prioritized and aural and visual warnings are triggered as necessary. The ECAM system is described in detail in chapter 31, Flight Instruments. ECAM generated autoland warnings are discussed in chapter 22, Autoflight.

Failures relating to a specific system are described in detail in the appropriate AOM chapter. For example, fire warnings are discussed in chapter 26, Fire Protection. Procedures relating to a specific failure are discussed in the corresponding COM section. The Flight Augmentation Computers generate numerous warnings, including:

- stall warnings (STALL warnings, discussed in chapter 27, Flight Controls),
- energy warnings (SPEED warnings, discussed in chapter 22, Autoflight), and
- windshear (WINDSHEAR warnings, discussed in chapter 22, Autoflight).

Independent warning systems discussed in this chapter are:

- the takeoff configuration warning (including the takeoff and landing memos),
- an Enhanced Ground Proximity Warning System (EGPWS),
- an altitude alert system, and
- a Traffic Alert and Collision Avoidance System (TCAS).

Warning System Priority

The TCAS, GPWS, and FACs provide warnings that direct the pilot to maneuver the aircraft in a specific direction. Although unlikely, it is theoretically possible for more than one of these warnings to be present at one time. To prevent simultaneous and possibly conflicting warnings, the following priority has been assigned:

- stall warnings,
- windshear,
- EGPWS, and then
- TCAS.

For example, a EGPWS PULL UP warning automatically inhibits a TCAS DESCEND warning.

External Warning Horn

The external warning horn sounds on the ground under the following conditions**:**

- an APU fire warning exists, or the APU has automatically shutdown due to a fire warning (chapter 26, Fire Protection),
- the avionics bay is receiving inadequate cooling on the ground (chapter 21, Air Conditioning and Pressurization), or
- one or more ADIRUs is powered by the aircraft batteries (chapter 34, Navigation).

Takeoff Configuration Warning

Description

The Takeoff Configuration (T.O. CONFIG) warning provides aural and visual warnings in the event a takeoff is attempted with the aircraft in an unsafe configuration. The T.O. CONFIG warning checks the following aircraft configuration items:

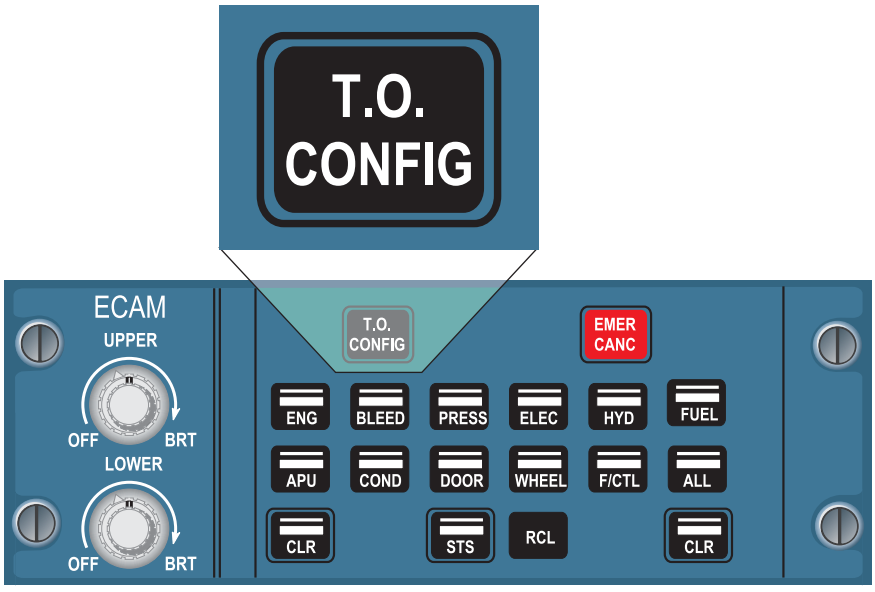
- slats/flaps in the takeoff configuration (flaps 1, 2, or 3),

  Note: The flap 2 setting is not used by Delta for takeoff.

- pitch trim or rudder trim within takeoff limits,
- external doors closed,
- side stick controller not disabled,
- speedbrake panels not extended, and
- wheel brake temperature less than 300 degrees.

T.O. CONFIG Warning Test

The T.O. CONFIG warning is tested by depressing the T.O. CONFIG pb on the ECAM control panel. The warnings occur if any item is not in the proper takeoff configuration. Pressing this pb will also display the takeoff memo on the upper ECAM.



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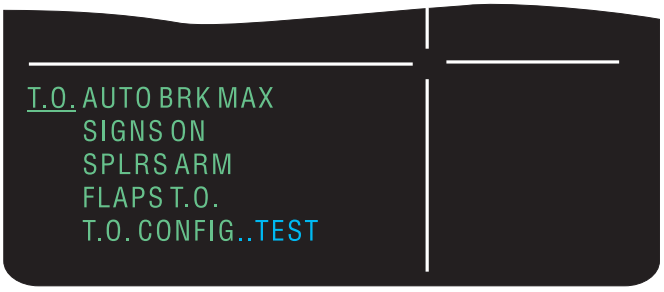
Note: Prior to engine start, the condition of the aircraft doors is not tested. The only item which is usually improperly configured during preflight is the slats/flaps. If the slats/flaps are at a takeoff setting, the T.O. CONFIG warning does not occur. For example, if the aircraft has been deiced with the flaps extended the warning may not sound during preflight.

Takeoff Configuration Warning (continued)

T.O. CONFIG Warning Test (continued)

Testing the T.O. CONFIG with the E/WD takeoff memo displayed changes the T.O. CONFIG...TEST message from blue TEST to green NORMAL if all tested systems are in the takeoff configuration.

Before Test:



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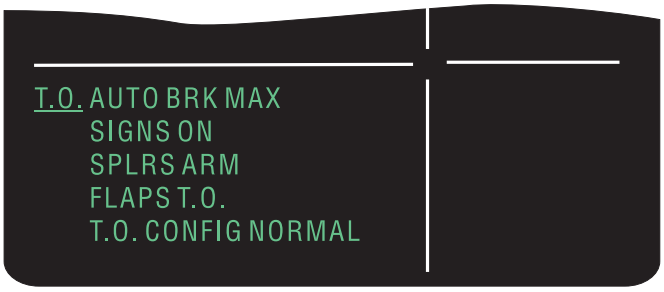
After Test



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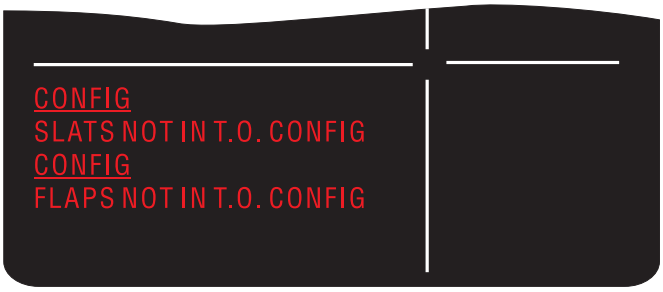
Note: The takeoff memo is automatically displayed two minutes after engine start. It will also be displayed whenever the TO CONFIG pb is pushed with an engine running. However, automatic display of the takeoff memo will not occur if the ENG MODE selector was not returned to NORM after engine start.

If the aircraft is not in the proper configuration when takeoff thrust is applied, a red MASTER WARN light, continuous repetitive chime (CRC), and corresponding ECAM message is displayed.



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The example above is the correct annunciation during the preflight check of the T.O. CONFIG warning.

Takeoff Configuration Warning (continued)

Additional Takeoff Warnings

Three additional warnings (if applicable) are provided when takeoff thrust is applied:

- parking brake ON, and
- flex temperature not set, and
- thrust levers not set.

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Note: If the parking brake is on, a red MASTER WARN light, CRC, and an ECAM memo are displayed when the thrust exceeds a preset level.

If a flex temperature was not entered into the MCDU, and the thrust levers are placed into the FLX detent on takeoff, an amber MASTER CAUTION light, single chime, and an ECAM memo are displayed.

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This warning can be cleared by advancing the thrust levers to the TO/GA position.

If a flex temperature was entered into the MCDU and the thrust levers are not advanced as far as the FLX detent, an amber MASTER CAUTION light, single chime, and an ECAM memo are displayed.

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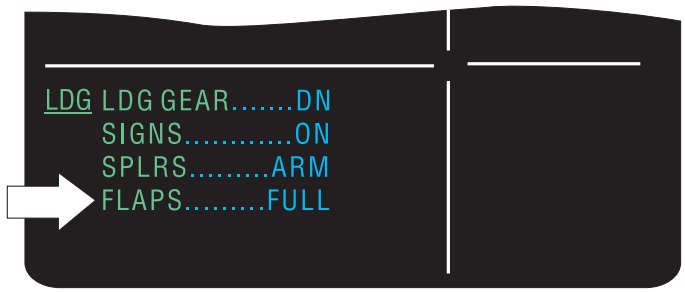
Takeoff Configuration Warning (continued)

Landing Memo

A landing memo is automatically displayed below approximately 2,000 feet AGL. The required flap setting for landing can be modified by using the EGPWS LDG FLAP 3 pb (discussed in section 85.20).



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Enhanced Ground Proximity Warning System (EGPWS)

Overview

The Enhanced Ground Proximity Warning System (EGPWS) is functionally divided into five “basic” modes, and the enhanced “terrain” modes. The basic modes are essentially identical to the modes 1-5 on earlier GPWS systems, and use the number one radar altimeter to monitor terrain clearance. The basic modes generate warnings when any of the following conditions exist:

- excessive sink rate,
- excessive terrain closure rate,
- altitude loss after take off or go-around,
- unsafe terrain clearance (includes “too low gear” and too low flaps” warnings), or
- excessive deviation below the ILS glide slope.

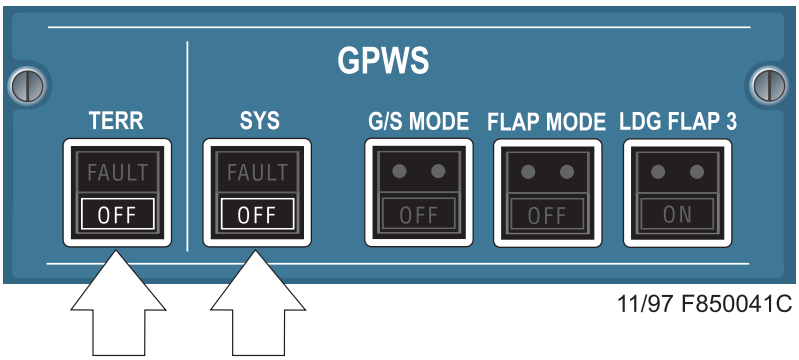
The EGPWS utilizes a worldwide terrain database including peaks and man-made obstacles and compares the aircraft’s GPS position and its current barometric altitude to the terrain database altitude. Pilots can display database terrain on their navigation displays in a manner similar to the radar image. Warnings are generated by the terrain modes when:

- the aircraft penetrates a database created “terrain clearance floor”, or
- the aircraft’s projected flight path causes database terrain to penetrate a computed caution or warning envelope.

All EGPWS warnings are modified for specific database airports with unusual terrain. Aural and visual warnings are generated when the aircraft is close to the ground and a potentially dangerous situation is detected.

System Design

The basic modes and the terrain modes are almost completely independent. Most failures of the basic modes will not affect the terrain modes, and vice versa. However, the loss of certain inputs (RA 1, for example) may cause all modes to fail. To completely inhibit all EGPWS warnings and cautions, both the TERR and SYS pbs on the overhead panel must be selected off.



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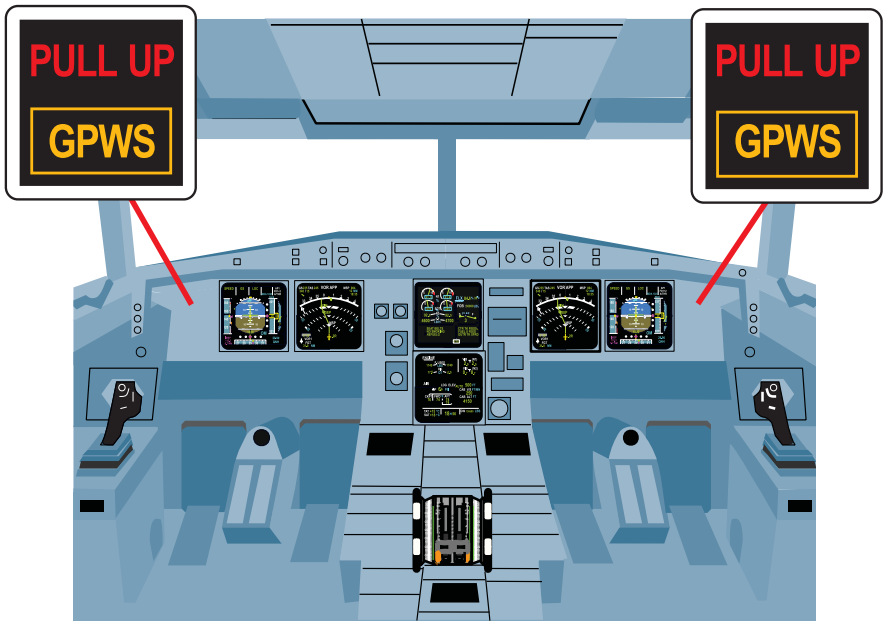
EGPWS Warnings

Visual Warnings

Visual warnings are provided by illumination of the PULL UP / GPWS pbs located on the captain and first officer instrument panels.



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The red GPWS portion of the PULL UP / GPWS pbs will illuminate for all EGPWS warnings and cautions except excessive deviation below glide slope.

Note: Depressing an illuminated PULL UP / GPWS pb has no effect.

The amber GPWS portion of the PULL UP / GPWS pbs will illuminate when excessive deviation below the glide slope is experienced.

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Depressing an illuminated PULL UP / GPWS pb cancels both the aural GLIDE SLOPE warning and the light.

Aural Voice

Synthesized aural voice warnings are generated as appropriate. These warnings are heard through the cockpit speakers regardless of the volume control position.

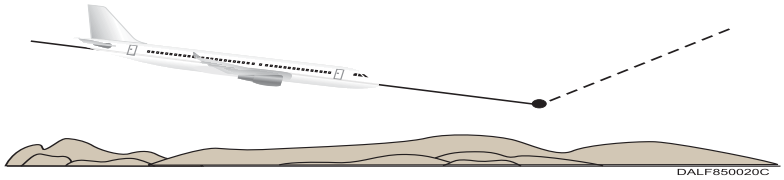
Note: It is possible to cancel false aural warnings with the EMER CANCEL pb on the ECAM control panel. However, cancelling EGPWS aural warnings must be accomplished only when allowed by Delta procedures.

EGPWS Basic Modes

EGPWS - Excessive Sink Rate Condition

Purpose of Message

When an excess sink rate has been detected, the EGPWS generates a SINK RATE warning.

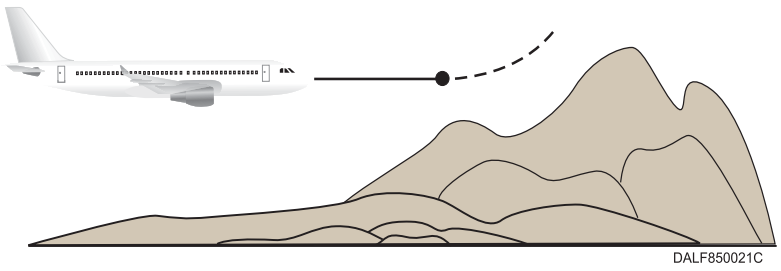


When the sink rate becomes critical, and immediate pilot action is required, an aural “WHOOP WHOOP, PULL UP” command will be repeated until the critical sink rate is arrested.

EGPWS - Excessive Terrain Closure Rate Condition

Purpose of Message

When the radio altimeter height indicates that the aircraft is flying close to the ground (in cruise or landing configuration) and senses rising terrain below the aircraft, the system assumes the terrain will continue to rise in front of the aircraft. This results in a “EGPWS TERRAIN, TERRAIN....PULL UP” aural warning continuously sounding.



An aural TERRAIN warning will be repeated continuously until a safe altitude is obtained.

EGPWS Excessive Obstacle Closure Rate Condition

Purpose of message:

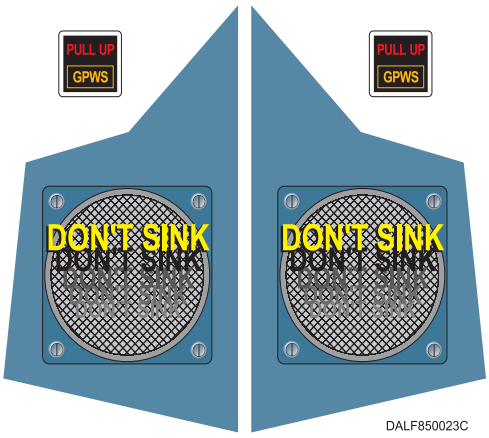
When a man-made obstacle is sensed along the aircraft path, the following warnings are displayed:

- an EGPWS aural “OBSTACLE AHEAD...PULL UP,”
- terrain will automatically be displayed even if the TERR ON ND pb has not been selected,
- solid red areas will be displayed on the ND,
- OBST AHEAD will appear on the ND (red), or
- PULL UP (red) will illuminate on the PULL UP / GPWS pb.

EGPWS - Altitude Loss After Takeoff/Go-Around Condition

Purpose of Message

When the EGPWS detects a sink rate after the initial climb during takeoff or go-around, a repeated “DON'T SINK” aural warning occurs.



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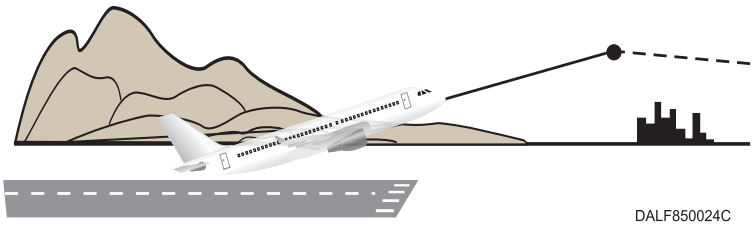

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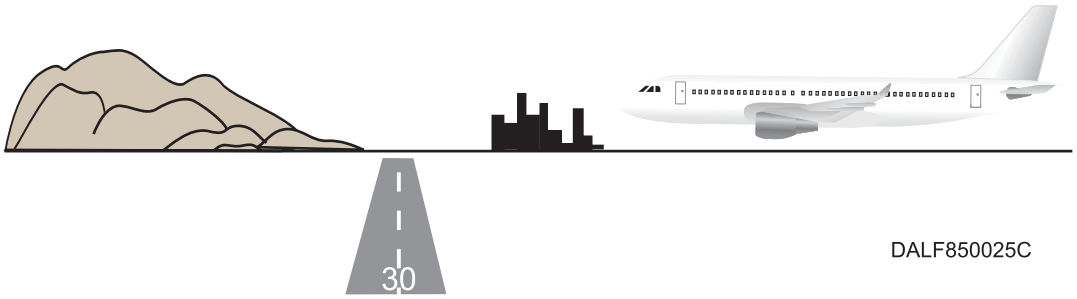
EGPWS - Unsafe Terrain Clearance Condition

Purpose of Message

When radio altimeter height indicates that the aircraft is too close to the ground with flaps, and/or landing gear not in the landing configuration, the EGPWS will generate a continuous “TOO LOW, FLAPS” or “TOO LOW, GEAR” aural warning as appropriate. At higher airspeeds, these conditions result in a “TOO LOW, TERRAIN” aural warning.



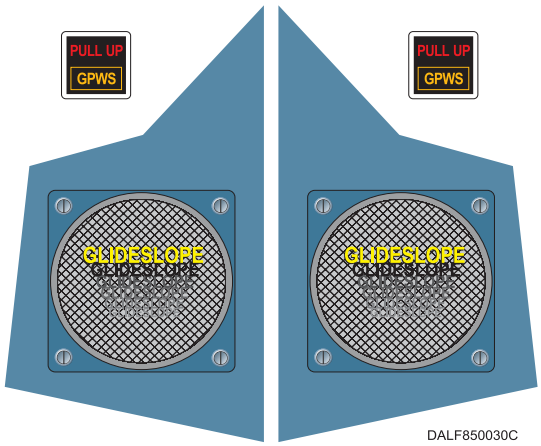
Correcting the landing gear, flaps setting, or increasing altitude will cancel this warning.

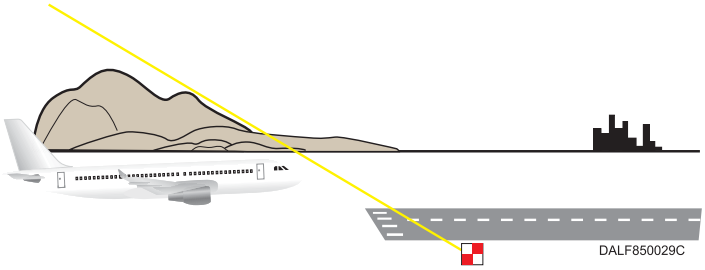
Note: The required flap setting for landing is either flaps FULL or CONF 3. The LDG FLAP 3 pb on the overhead GPWS panel is selected to ON to inform the system of a planned CONF 3 landing (refer to section 85.20).

EGPWS - Excessive Deviation Below Glide Slope Condition

Purpose of Message

When an excessive deviation below the glide slope occurs during an ILS approach at low altitudes, the GPWS generates a continuous “GLIDE SLOPE” aural warning, and illuminates the GPWS light in the PULL UP / GPWS pbs. The volume level of the synthesized voice “GLIDE SLOPE” warning will increase as the aircraft gets closer to the ground.



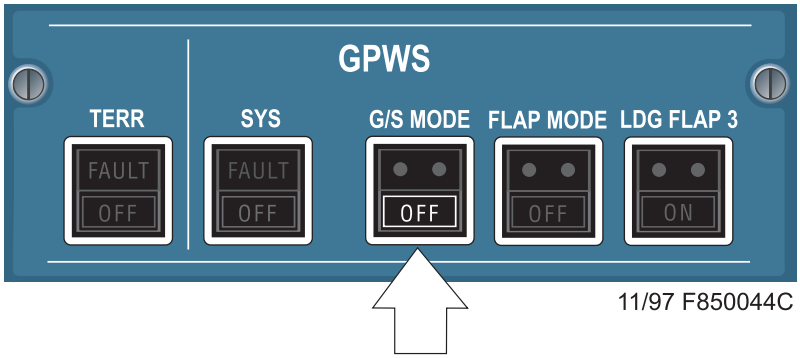


Depressing an illuminated PULL UP / GPWS pb cancels both the “GLIDE SLOPE” aural warning and light.

Inhibiting G/S Warning

Depressing the G/S MODE pb (OFF selected) on the overhead panel inhibits G/S warnings.

For example, this would be accomplished prior to flying a localizer only or LDA without glideslope.



Terrain Modes

General

The terrain modes use a world wide terrain and runway database to constantly monitor the aircraft's altitude relative to the surrounding terrain. The Terrain Clearance Floor TCF) feature creates a protective altitude layer on top of terrain near airports. The predictive terrain alerting feature computes warning envelopes that can provide up to 60 seconds additional warning time of hazardous terrain.

The pilots can manually display terrain on their navigation displays. When level, terrain more than 2,000' below the aircraft is not displayed, and in cruise no terrain should be displayed. During takeoff and approach, terrain is displayed in color, depending on the relative altitude of the terrain. Terrain is automatically displayed on the NDs when terrain alerting cautions and warnings are generated.

Design

The terrain modes use GPS (FMGC 1 as a back-up) position, RA 1, ADIRU 1, and the captain's barometric altimeter setting and compares the aircraft's position and projected flight path to the terrain database. There is no backup capability for the loss of any of these inputs, except GPS.

Caution: *The captain's barometric altimeter setting (as set on the FCU) is used for calculating terrain clearance. An error in the barometric setting will cause corresponding errors in the terrain mode cautions and warnings.*

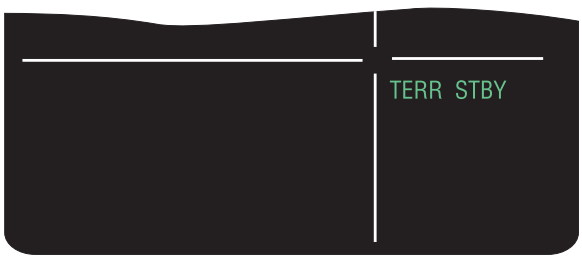
Terrain database

The database encompasses more than 95% of the world surface, and all runways longer than 3,500 feet with an instrument approach. Terrain data is stored using variable resolution. The resolution varies from 5 NM to 1/4 NM, with the best resolution "cells" located near frequently used airports. The database is also modified for specific airports with unusual terrain. It does not presently include most man made structures or towers. The database is routinely updated by maintenance.

Note: All civilian and most military airports in the western hemisphere (North, Central, and South America) that have at least 3,500 feet of hard surface runway and an instrument approach are in the EGPWS database. All Delta A320 regular, alternate, refueling, and provisional airports are in the EGPWS database.

Terrain Standby Mode

An ECAM TERR STBY message is displayed if the FMS position error exceeds a specific limit. It remains displayed until the FMS position error decreases below the limit. The ECAM TERR STBY message is inhibited whenever the aircraft altitude exceeds 8,000 feet above surrounding database terrain.



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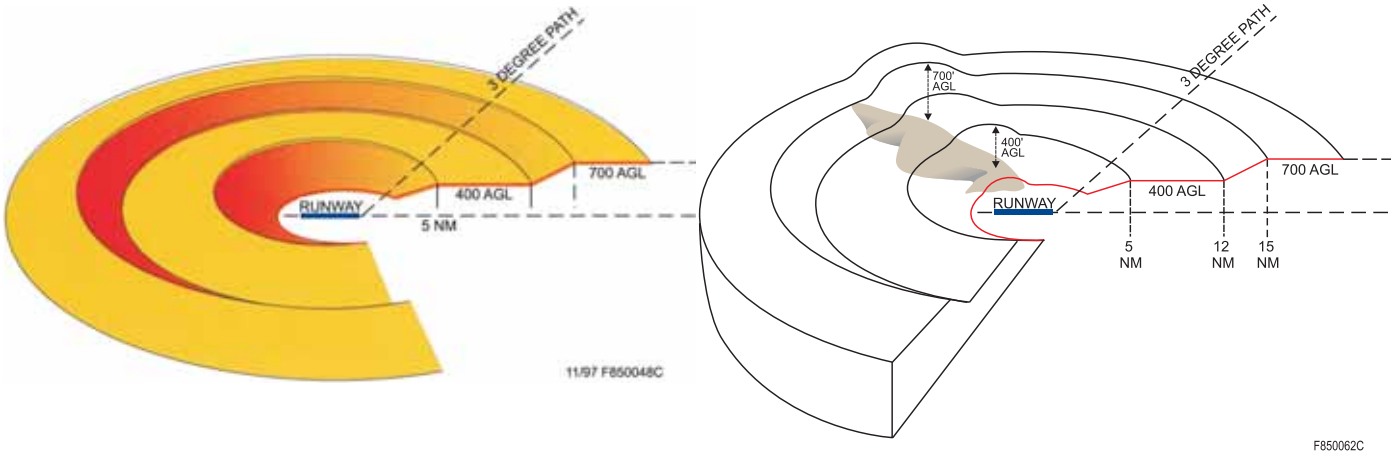
Terrain Clearance Floor Mode

Description

The Terrain Clearance Floor (TCF) is designed to provide additional protection for non-precision approaches and visual approaches. A minimum safe altitude “floor” is computed around database airports. The floor is layered on top of existing terrain.

The floor is calculated as follows: starting 1/2 nm from the airport at 30 feet AGL, the floor increases at approximately 100’ per mile until it reaches 400’ AGL at 5 nm. It remains constant until 12 nm, when it increases again to 700’ AGL at 15 nm. This 700’ floor then extends indefinitely. Pilots are not required to memorize this formula.

The TCF warning is not predictive, and the aircraft must actually penetrate the TCF to trigger the warning. If the aircraft penetrates the TCF, an aural “TOO LOW, TERRAIN” warning is heard, along with illumination of the two red GPWS warning lights. Terrain is not automatically displayed for a TCF warning. The basic TCF is displayed on the left below. On the right is an example of the TCF being shifted up due to terrain.



False Warnings

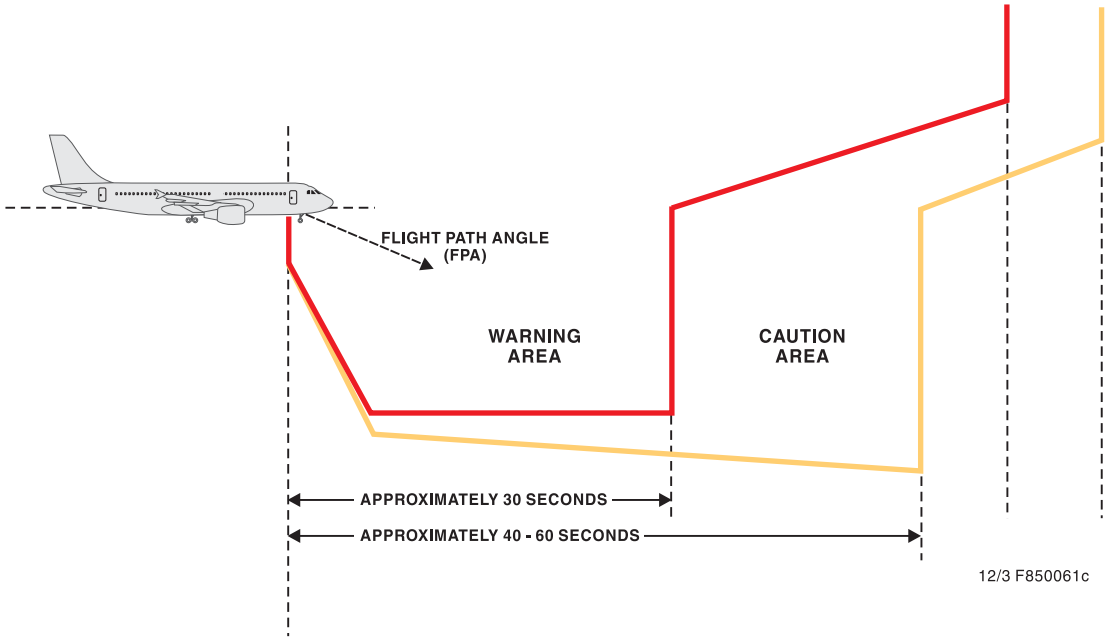
The TCF uses the nearest database airport in its calculations, which will **not** always be the aircraft’s intended destination. On rare occasions, a false warning may occur if the aircraft passes an airport significantly higher than the destination during the approach, and the FMS position error approaches the allowable maximum. In these rare cases, the EGPWS “thinks” that it is approaching hazardous terrain, even if the aircraft is on the centerline for the approach. The few airports that have been identified with this characteristic are identified in the appropriate 10-7 or 20-7 Jeppesen pages. For these specific approaches, the Jeppesen page will direct the crew to select the overhead TERR pb to off prior to the approach.

If the aircraft is approaching an airport that is not in the EGPWS database (due to an emergency divert, for example), a false TCF warning may be generated.

Terrain Alerting Mode

Description

The terrain alerting mode provides a predictive warning of terrain ahead of the aircraft. The EGPWS automatically monitors the aircraft's position and projected flight path relative to hazardous terrain. It monitors database terrain ahead of the aircraft, and +/- 30 degrees of the aircraft's heading. The EGPWS uses current aircraft speed, altitude, flight path, and a conservative performance model in computing cautions and warnings. Predictive warnings up to 60 seconds are provided for hazardous terrain. The warning and caution envelopes are shown below.



If the aircraft is turning, the system will project terrain clearance into the turn. The terrain alerting algorithm assumes that the current turn rate will remain constant. If the turn rate changes, the terrain alerting algorithm recalculates terrain clearance. Terrain well outside the turn radius does not cause terrain warnings. This allows the aircraft to maneuver VFR without generating false warnings. In addition, a slight amount of terrain clearance inside and outside of the turn is projected to allow for variations in turn rates. This feature allows the aircraft to maneuver during VFR arrivals or departures at airports with high terrain (Vail, Colorado, for example) without causing false warnings.

The terrain alerting algorithm is further modified at low altitudes to allow normal rates of descent without causing false warnings.

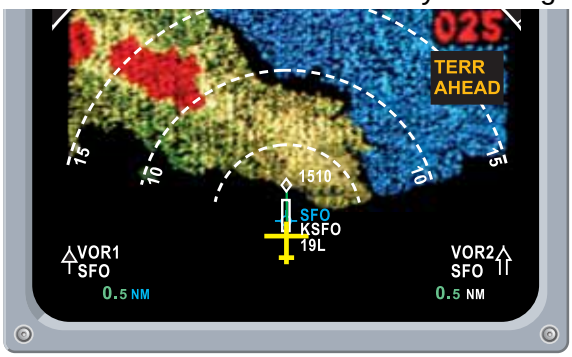
Terrain Alerting Mode (continued)

Terrain Alerting (continued)

Terrain or Obstacle Caution

If the aircraft is within 40-60 seconds of hazardous terrain (based on the current flight path and ground speed), an aural “CAUTION, TERRAIN or OBSTACLE AHEAD” is generated, amber GPWS lights illuminate, and an amber TERR AHEAD or OBST AHEAD message is displayed on both NDs. A Terrain caution automatically displays terrain on both NDs. When a caution is triggered, terrain will automatically be displayed on the ND, even if the TERR ON ND pb has not been selected.

The EGPWS assumes that the aircraft’s flight path will continue at the current conditions (heading, rate of descent, ground speed, etc.) for the next 60 seconds.This may cause terrain cautions which can be corrected by reducing the rate of descent.



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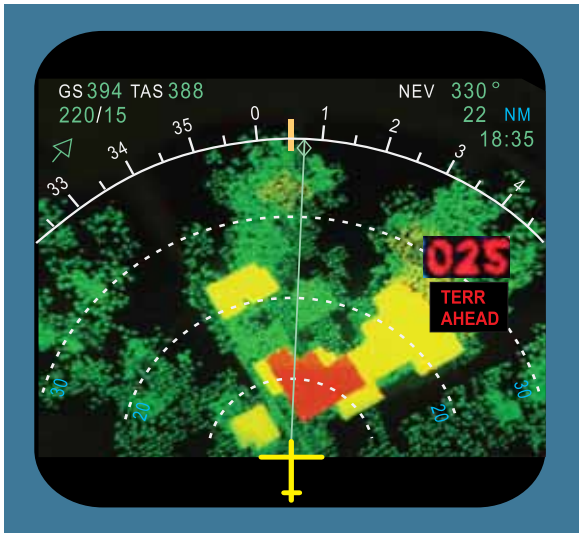
Terrain or Obstacle Warning

If the aircraft approaches within approximately 30 seconds of the hazardous terrain or man made obstacle, an aural warning “TERRAIN AHEAD, PULL UP” is generated, the red PULL UP lights illuminate on the GPWS pb and a red TERR AHEAD or OBST AHEAD message is displayed on both NDs. When a Terrain warning automatically displays terrain on both NDs. When a warning is triggered, terrain will automatically be displayed on the ND, even if the TERR ON ND pb has not been selected. The aural message will continue to repeat until the condition is corrected.



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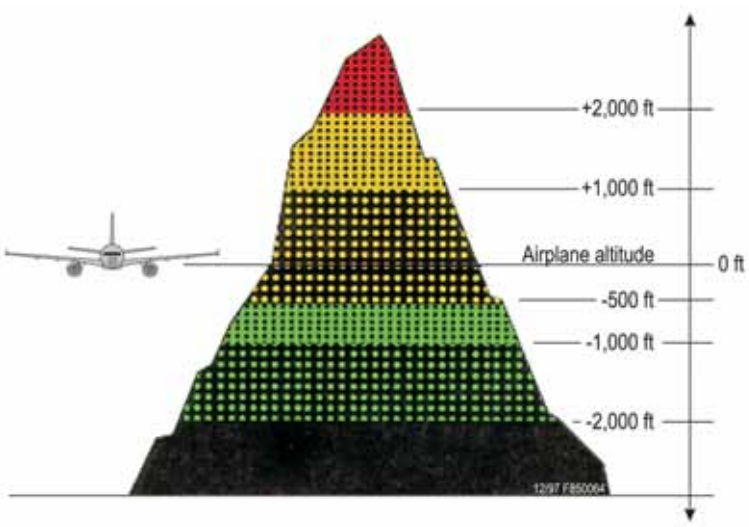
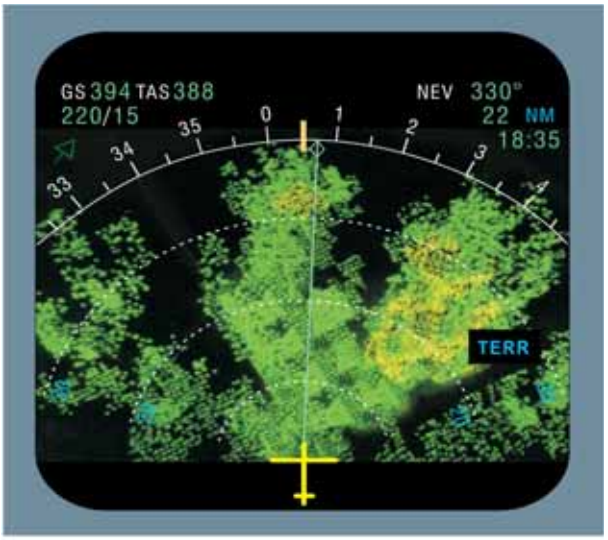
Terrain Displays

Terrain Displays

The EGPWS allows the pilots to independently display terrain on their ND's in a manner similar to the radar display. Display of terrain has priority over the radar display. If terrain is displayed on the ND, the radar image is not available. Terrain is automatically displayed during terrain cautions and terrain warnings. It is not displayed automatically for TCF warnings.

The terrain data is displayed using various densities of dots and colors which automatically vary depending on the aircraft's altitude and the aircraft's predicted flight path relative to the terrain.





Terrain more than 2,000 feet below the aircraft is not displayed. No terrain should be displayed on the ND during cruise. During a descent, additional terrain is displayed when the rate of descent exceeds 1,000 ft/min. The specific algorithm for terrain display is complex. However, as a general rule, the cutoff altitude for terrain display is lowered by approximately 1/2 the aircraft's rate of descent.

The resolution of the terrain database varies from 1/4 nm to 5 nm depending on the specific location. Therefore the minimum size terrain "cell" displayed on the ND will be 1/4 nm square. The best resolution is near frequently used airports. The terrain database does not include man made objects such as towers. The terrain database is updated on a routine basis and resolution is constantly increasing.

Warning: The terrain display is not to be used for navigation of the aircraft.

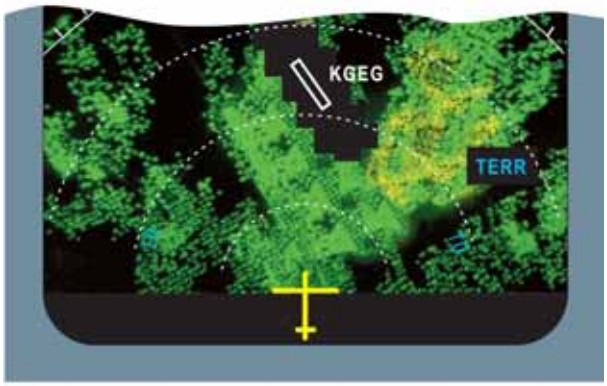
Solid terrain displays (yellow or red) indicate that the predicted flight path will penetrate the caution or areas.

ND Terrain Display (continued)

Terrain Displays (continued)

At low altitudes, terrain that is below an altitude 400 above the nearest EGPWS database airport altitude is not normally displayed. This allows the terrain contours around the destination airport to be displayed. All terrain around the database airport (within one database "cell" of the runway) and within 1 nm of the extended runway centerline is also not displayed.

Pilots should always "land in the black" areas of the terrain display. While on the ground, all terrain less than 400 feet above the departure airport is not displayed.



During final approach, pilot's should not see any yellow or red terrain along their extended flight path. Additional terrain below the normal cutoff altitude of 400 feet AGL will be displayed if the EGPWS determines that it may become a hazard.

Terrain data can be displayed in any ND display mode except PLAN. Any ND range (10-320 nm) can be used. Better resolution is provided at the lower ND ranges. The following table describes the approximate ND depiction of terrain. However, the actual depiction of the terrain will vary according to EGPWS logic. There is no requirement for pilots to memorize these parameters.

Color and Density	Altitude of Terrain
no display of terrain	more than 2000' below
light density green dots	2000'-1000' below
medium density green dots	variable altitude - 1000' below
medium density yellow dots	500' below - 1000' above
high density yellow dots	1000' above - 2000' above
high density red dots	more than 2000' above
solid bright yellow	terrain within caution area
solid bright red	terrain within warning area
magenta (rare case)	no data in terrain database

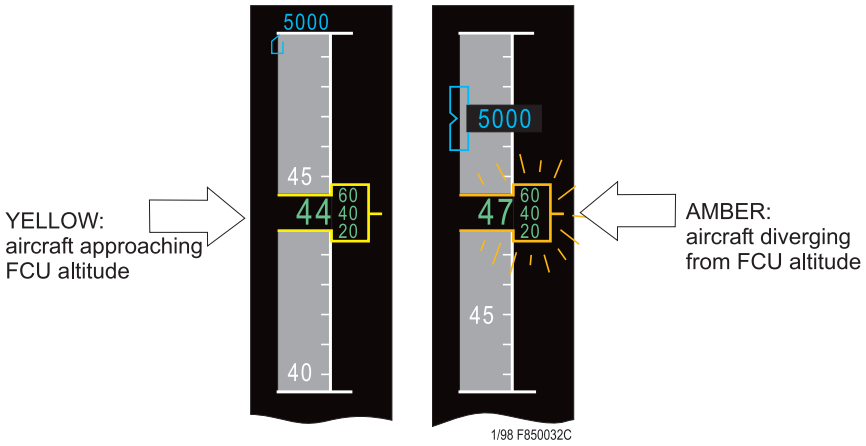
Altitude Alert

Description

An altitude alerting system provides visual and aural warnings when the aircraft approaches the selected FCU altitude or the aircraft deviates from the selected FCU altitude.

Visual Warning

The altitude window on the PFD altimeter pulses in yellow when the aircraft approaches the FCU altitude, or amber when it deviates from the FCU altitude by more than an appreciable amount.



Aural Warning

Although sometimes automatically inhibited, the aural warning (continuous C chord) occurs when:

- the aircraft is being manually flown and approaches within 750 feet of the FCU altitude. This warning is automatically canceled as the aircraft continues to approach the selected altitude, or
- the aircraft deviates from the FCU altitude by more than 250 feet. This aural warning continues until:
  - the aircraft returns to the FCU altitude,
  - a new altitude is selected, or
  - the warning is manually canceled.

Aural warnings can be manually canceled by:

- depressing either MASTER WARN pb (the MASTER WARN pb does not illuminate) or
- depressing the EMER CANC pb on the ECAM control panel.

Altitude Alert Inhibitions

The altitude alert is automatically inhibited:

- when the slats are out with landing gear selected down,
- during approach when G/S or FINAL modes are engaged, or
- when at least one autopilot is engaged.

Windshear

Windshear Detection

The FAC has the capability to detect windshear and provide warnings.

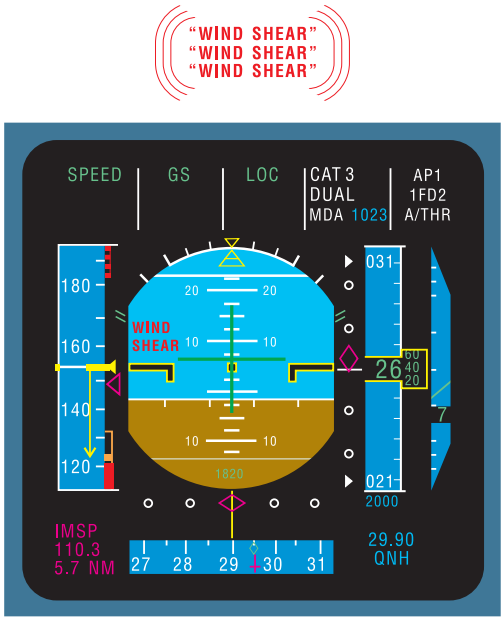
Note: Windshear warnings function during takeoff and landing when the aircraft is:

- below 1300 feet AGL, and
- at configuration 1 or greater.

These warnings are provided independent of the position of the FAC ON/OFF pb on the overhead panel, as long as the FAC is operable. The windshear warnings function with the flaps at one or greater at low altitudes during takeoff and landing. The airspeed trend arrow (available at all times) provides additional indications of windshear.

Windshear warnings consist of:

- a red WINDSHEAR PFD message, and
- an aural “WINDSHEAR” warning.



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When the windshear warning is active, the flight director pitch bars will command an optimum pitch attitude for recovery. The windshear warnings will also function with both flight directors selected off, however, pitch command bars will be not present.

Warning

Windshear conditions that occur at higher altitudes or clean configurations will NOT trigger a windshear warning.

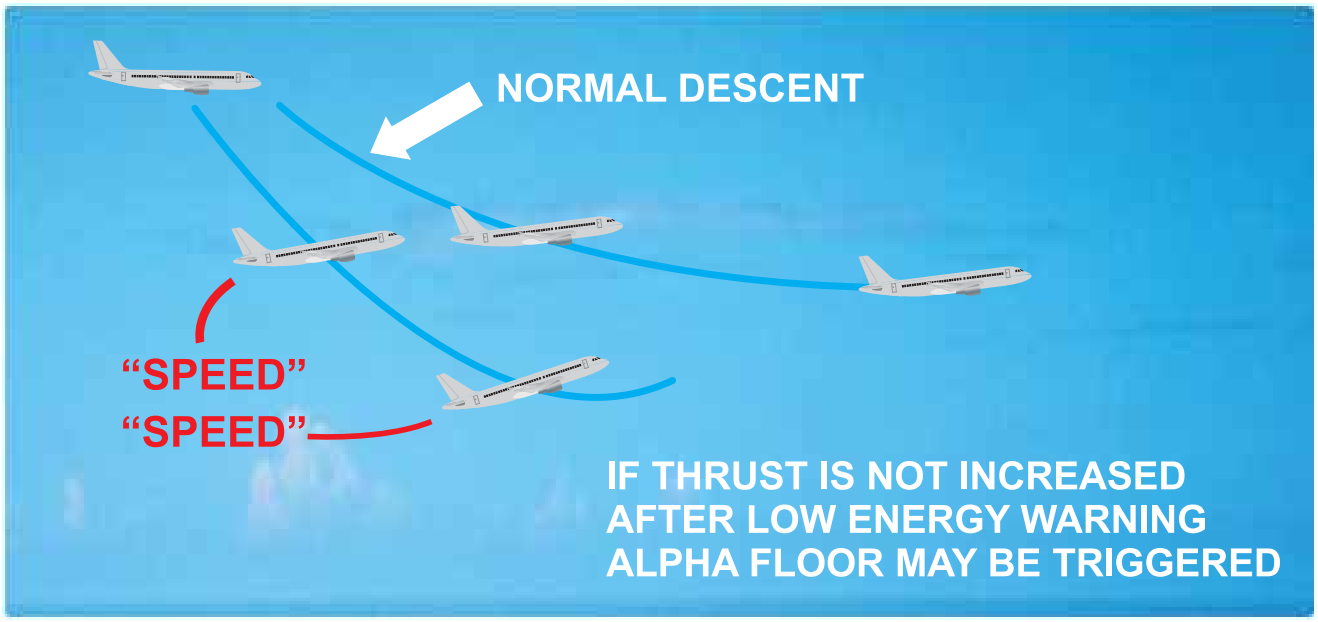
Low Energy Warning

Overview

At low altitudes, the FACs constantly monitor the aircraft's flight path and velocity. The FACs independently compare the aircraft's energy level (airspeed, descent angle, and angle of attack), and provide a warning whenever a warning threshold is reached. This aural "SPEED, SPEED, SPEED" warning indicates that the pilot should increase thrust, which will have the result of decreasing the angle of attack, decreasing the descent angle, and/or increasing the airspeed.

The SPEED warning is designed to function at an angle of attack prior to Alpha Floor. It is not dependent on control law status, unlike Alpha Floor, and will function in alternate and direct laws (assuming at least one FAC is operational). This warning is independent of autothrust status and will function with autothrust off or inoperative. It operates in the following conditions only:

- below 2,000 feet and above 100 feet AGL,
- when Alpha Floor is not engaged, and
- configurations 2 or greater.



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Controls and Indicators

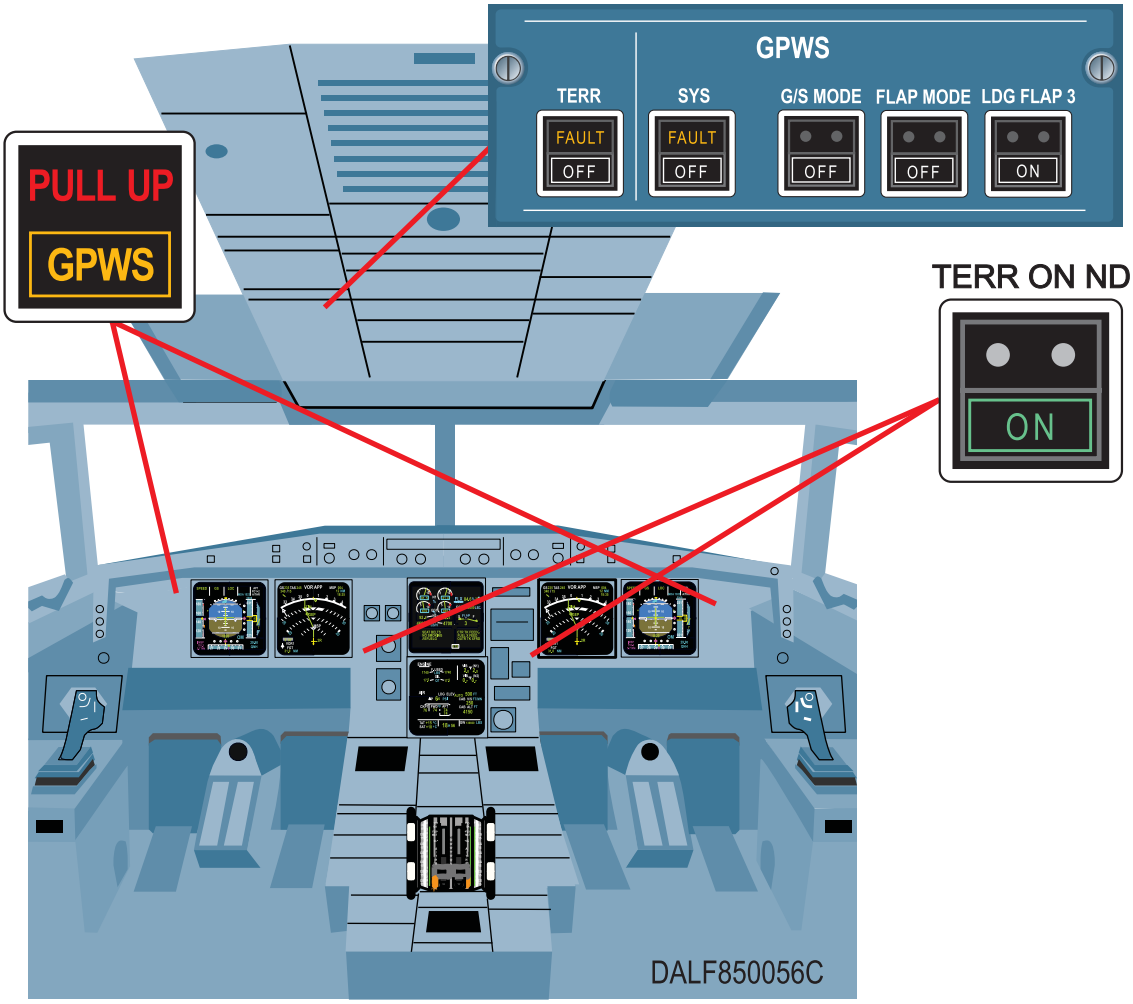
Location of Enhanced Ground Proximity Warning System Controls and Indicators

Introduction

Controls and indicators associated with the Enhanced GPWS (EGPWS) are located on the overhead and instrument panels of the cockpit.

Location

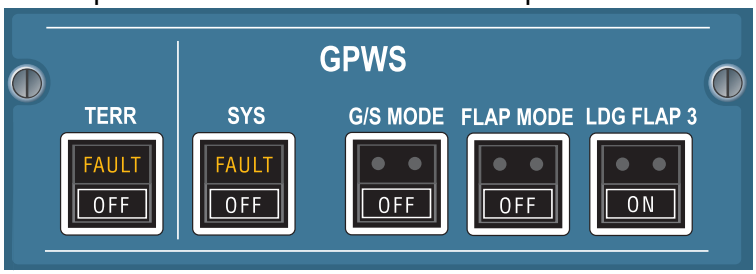
The EGPWS controls and indicators are located on the overhead panel and instrument panel, as shown below.



Overhead Panel

Location

The EGPWS control panel is located on the overhead panel.



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All functions of the EGPWS system are selected on and are operating normally when the pbs are in a lights out condition.

TERR pb

The TERR (Terrain) pb controls the operation of the terrain features of the EGPWS (Terrain Clearance Floor, Predictive Terrain Warnings, and Terrain Awareness Display). This pb does not affect the operation of the basic modes of the EGPWS.

The TERR pb has three possible configurations.

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On (lights out): The terrain features of the EGPWS are operating normally. The pb must be ON for terrain warnings to function, and for terrain to be displayed on the NDs.

OFF (white): The terrain features of the EGPWS have been manually selected OFF.

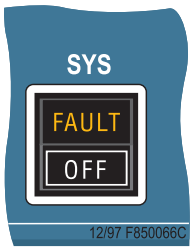
FAULT (amber): The terrain features of the EGPWS are inoperative. All warnings and displays associated with the terrain features are inhibited.

Note: The basic GPWS modes remain functional.

SYS pb

The SYS (System) pb controls the operation of the basic modes of the EGPWS. It does not affect the operation of the terrain features.

The SYS pb has three possible configurations.



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On (lights out): The basic modes of the EGPWS are operating normally.

OFF (white): The basic modes have been manually selected OFF.

FAULT (amber): The basic modes of the EGPWS are inoperative. All warnings associated with the basic modes are inhibited.

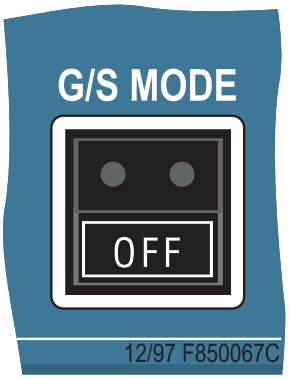
Note: The EGPWS (TERR) function remains operational.

Overhead Panel (continued)

G/S MODE pb

The G/S (Glide Slope) MODE pb controls the operation of the EGPWS G/S mode.

The G/S MODE pb has two possible configurations.



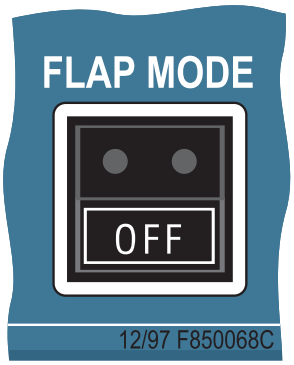
On (lights out): The G/S mode of the EGPWS is operating normally.

OFF (white): The G/S mode has been manually selected off. Excessive deviation below glide slope warnings have been manually inhibited. This is a normal action during localizer only and localizer-type directional aid approaches as described in FCTM.

FLAP MODE pb

The FLAP MODE pb controls the operation of the flap mode.

The FLAP MODE pb has two possible configurations.



On (lights out): The flap modes are operating normally.

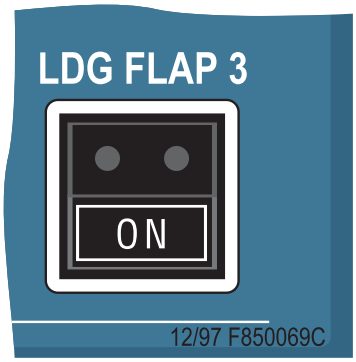
OFF (white): The flap modes (e.g., “TOO LOW, FLAPS”) are inhibited.

Overhead Panel (continued)

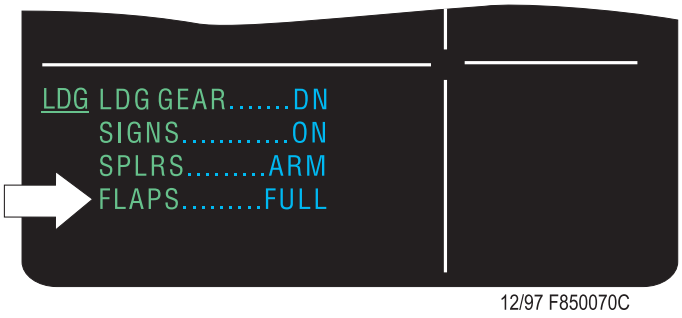
LDG FLAP 3 pb

The LDG FLAP 3 pb selects the required flap configuration for landing. It affects the EGPWS flap warnings and the ECAM landing memo.

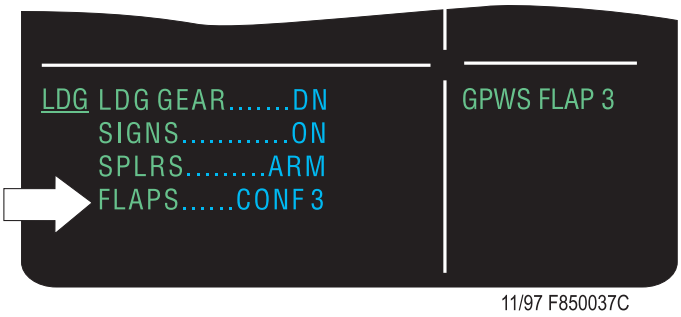
The LDG FLAP 3 pb has two possible configurations.



Lights Out: The normal configuration is lights out. The required flap configuration for landing is flaps FULL. EGPWS aural warnings (e.g., “TOO LOW, FLAPS”) will occur if the altitude is too low with the flaps not selected to FULL. The ECAM landing memo will require FLAPS.....FULL.



ON (white): The required flap configuration for landing is CONF 3. EGPWS aural warnings (e.g., “TOO LOW, FLAPS”) will occur if the altitude is too low with the flaps not selected to CONF 3. The ECAM landing memo FLAPS step will change to FLAPS..... CONF 3. An ECAM memo of this selection is shown below.

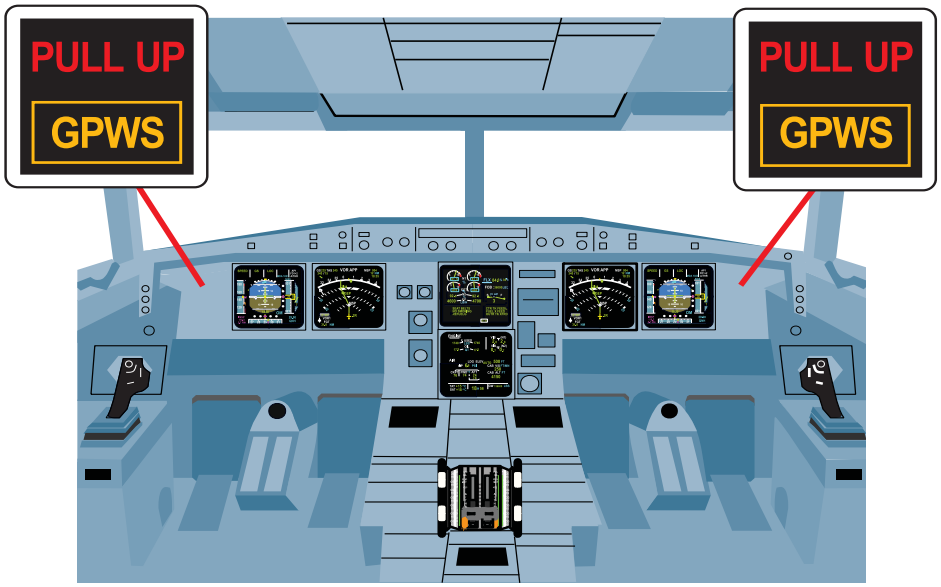


Note: Selecting the LDG FLAP 3 pb to ON is a normal operating procedure when operating into airports which require landings with FLAPS 3 for noise abatement, and during many abnormal procedures. Refer to the FCTM for additional information.

Instrument Panel

EGPWS WARNING LIGHT/TEST pbs

The EGPWS warning light/test pbs are located outboard of each PFD.



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GPWS Light On

The GPWS light illuminates red for all EGPWS warnings except excessive deviation below the glide slope.

Pushing an illuminated red GPWS warning light has no effect.

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The red GPWS light is accompanied by an aural warning as described in section 85.10.

G/S Light On

Both GPWS lights will illuminate amber when an excessive deviation below glide slope signal is detected.

The PULL UP warning can cancelled by pressing the illuminated pb. It can be permanently inhibited by selecting the overhead panel G/S MODE pb OFF.

DALF850018C

Instrument Panel (continued)

Testing the EGPWS

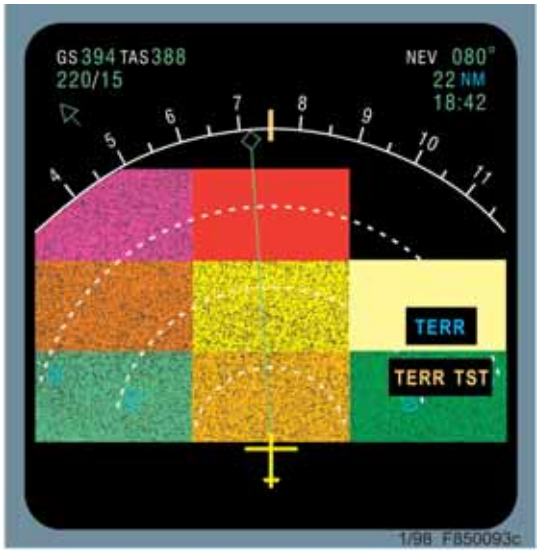
On The Ground

Momentarily pressing either PULL UP/GPWS warning light initiates the light test and aural annunciation sequence, as follows:

- the GPWS FAULT light TERR FAULT lights on the overhead panel illuminate,
- the instrument panel GPWS lights illuminate, and
- a “GLIDE SLOPE” aural warning is generated.

The sequence continues as follows:

- the instrument panel PULL UP/GPWS lights illuminate,
- a “PULL UP” aural warning is generated,
- a “TERRAIN, PULL UP” aural warning is generated,
- both instrument panel TERR ON ND pbs illuminate ON, and
- a terrain test pattern is displayed on both NDs.



At the completion of the test, all indications and displays revert to their previous configuration.

If the pb is held continuously or depressed again during test aural warnings, all of the possible aural warnings will be heard.

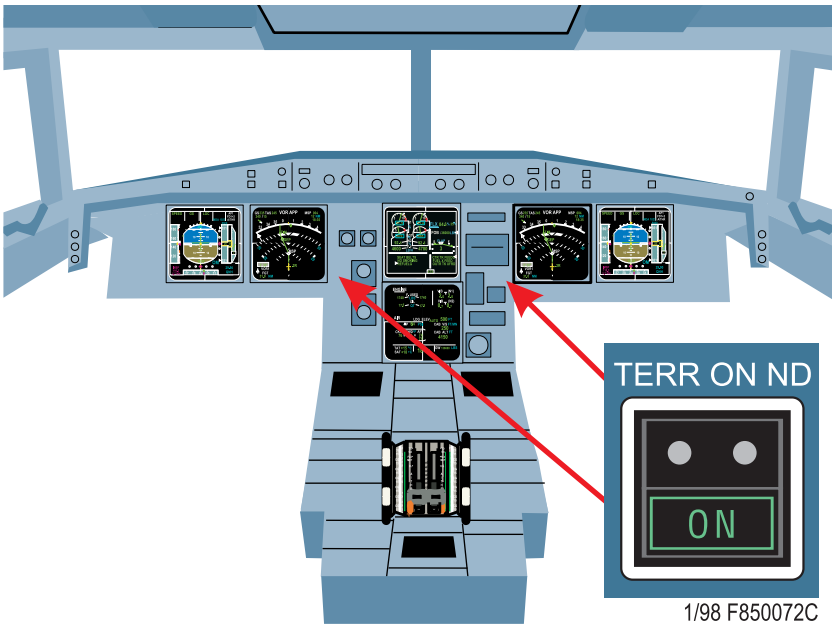
In Flight

Testing the EGPWS in flight by pressing either PULL UP/GPWS warning light will result in the same light test and aural sequence as described during the ground test. The in flight test will only function if no warnings are present, and when the aircraft altitude is above 2,000 feet AGL and below approximately 8,000 feet MSL.

ND Terrain Display

TERR ON ND pb

The TERR (Terrain) ON ND pbs are located inboard of each ND.



The TERR ON ND pb will not illuminate unless the overhead GPWS TERR pb is also selected on (lights out), and the FMGC 1 position is valid. During preflight, the IRS alignment must be completed.

Note: The terrain display has priority over the weather radar display. The TERR ON ND pb must be OFF for weather radar to be displayed.

The brightness of the terrain display is controlled with the same rheostat as the radar (the outer ring of the ND control).

Manual Control

Either pilot can select the terrain display independently.

Automatic Control

If an EGPWS terrain caution or warning occurs, terrain will automatically be displayed on both NDs. This display will automatically override the display of the weather radar.

To display the weather radar, the TERR ON ND pb must be manually deselected after the caution or warning is cancelled.

Terrain is not automatically displayed for EGPWS warnings as a result of the terrain clearance floor feature.

ECAM Messages

EGPWS ECAM

The following table list the ECAM memos associated with the EGPWS.

ECAM MEMO	Meaning
GPWS FLAP 3	The FLAP 3 pb has been selected ON. GPWS warnings will require flaps to be at CONF 3 for landing, and the ECAM landing memo will require CONF 3.
GPWS FLAP MODE OFF	The FLAP MODE pb has been selected OFF. All GPWS flap warnings have been manually inhibited.
TERR STBY	The FMS accuracy is less than that required for display of terrain data on the ND. This message is inhibited above approx 8,000 feet AGL.

Traffic Alert and Collision Avoidance System (TCAS)

General Description

General

The Traffic Alert and Collision Avoidance System (TCAS) is an independent airborne system designed to act as a backup to the ATC system and the “see and avoid” concept.

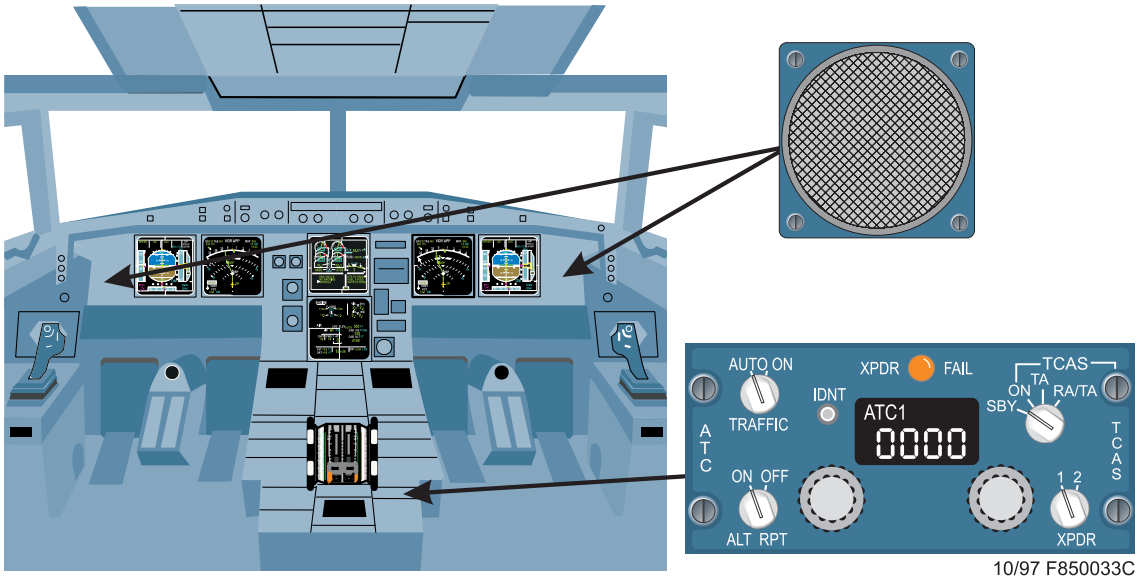
TCAS utilizes transponder replies from other aircraft. TCAS determines range, relative bearing, and relative altitude of the other aircraft (if their altitude function is operating). Flight paths are then predicted, and those aircraft paths which penetrate a protected caution area are annunciated on cockpit displays. These aircraft are called “intruder aircraft.”

TCAS generates two types of annunciations: a Traffic Advisory (TA) and a Resolution Advisory (RA). The TA provides the pilot with a Navigation Display (ND) depiction of the intruder aircraft's range, bearing, and relative altitude (when available). An RA provides an intruder aircraft ND depiction, and provides vertical evasive maneuvers.

TCAS continuously calculates tracked aircraft projected positions. TAs and RAs are constantly updated and provide real time advisory and position information.

TCAS can resolve multiple aircraft encounters.

TCAS cannot detect non-transponder equipped aircraft.



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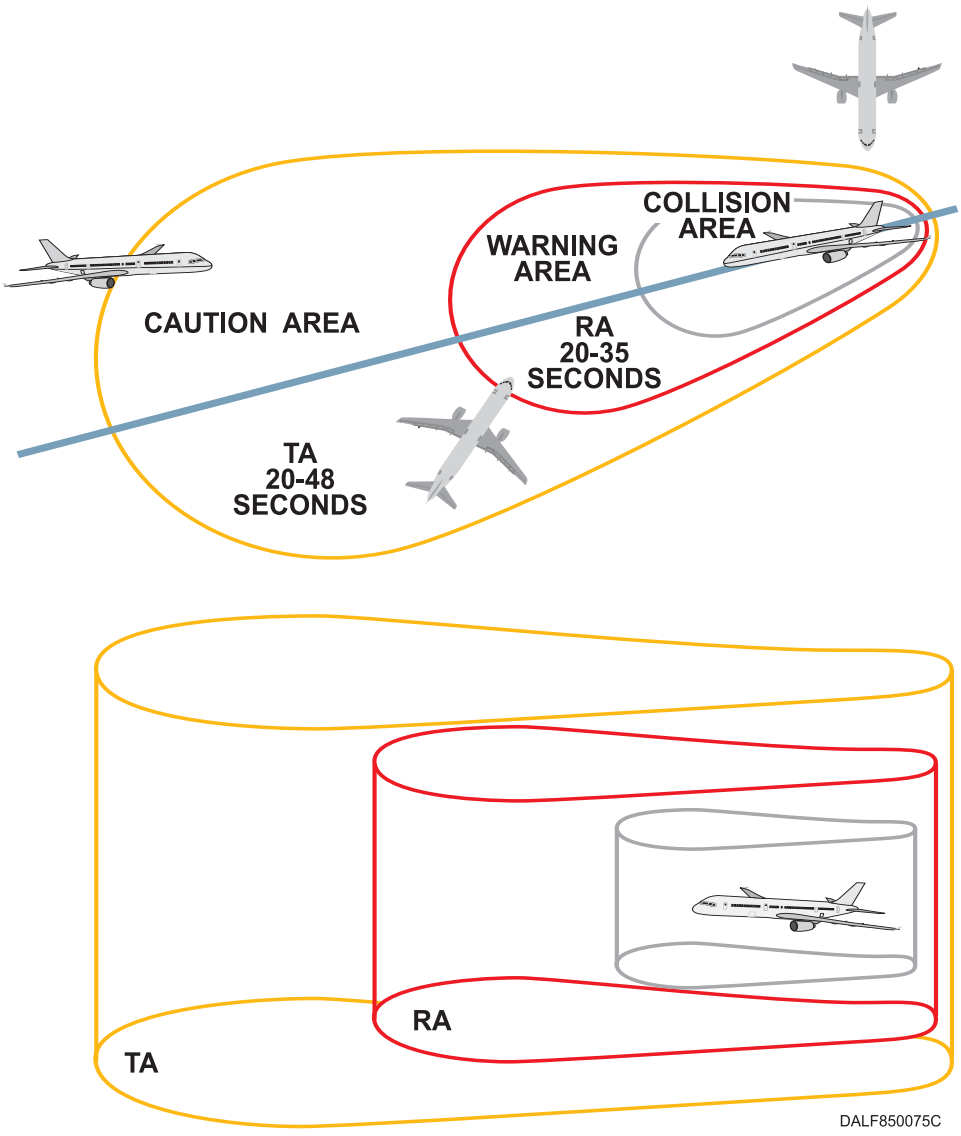
General Description (continued)

Operation

Based on received transponder replies, the TCAS computes two types of three dimensional areas around the TCAS equipped aircraft:

- a caution area, and
- a warning area.



TCAS provides a time based alert in that the physical dimensions of the caution areas vary as a function of the closure speed.

If an intruder aircraft is predicted to penetrate the caution area, a Traffic Advisory (TA) is generated. Intruder aircraft predicted to penetrate the warning area generate a Resolution Advisory (RA).

TCAS Advisories

Traffic Advisory

A Traffic Advisory (TA) is displayed approximately 20-40 seconds before the intruder aircraft's flight path is predicted to enter the collision area. The TA is announced aurally by the announcement “TRAFFIC, TRAFFIC.”

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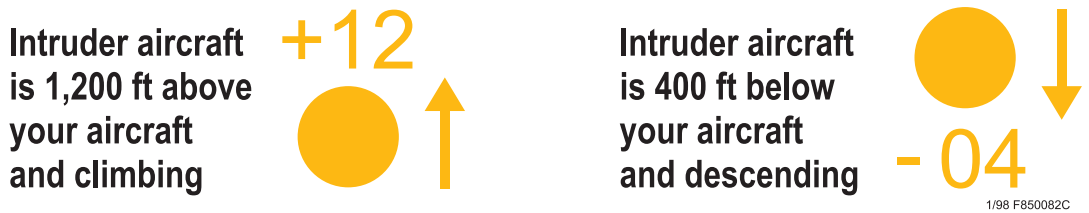
TA traffic are displayed on the ND as solid amber circles. The pilot can use this information as an aid in visually locating the intruder in order to avoid a conflict. No evasive maneuvers are required to maintain safe separation from TA traffic, and maneuvers based solely on TA displays should not be performed.

The intruder aircraft symbol is displayed at the correct range and bearing. Other data displayed includes:

- altitude relative to the TCAS aircraft and
- significant climb and descent rates.

Two examples are shown below.



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TCAS Advisories (continued)

Resolution Advisory

A Resolution Advisory (RA) is displayed within 20 seconds before the intruder aircraft's flight path is predicted to enter the collision area. The RA provides the pilot with vertical maneuvers to increase or maintain separation from intruder aircraft. An RA is only generated from altitude reporting intruders.

An RA is annunciated both visually and aurally. Two types of RA commands may be issued. The RA is either a:

- preventative advisory (vertical speed restrictions are displayed in red on the PFD) or
- corrective advisory (a change in vertical speed is commanded in green on the PFD).

When a preventative advisory is displayed, the vertical speed should not be changed into the red area indicated on the PFD vertical speed tape. In the example below, the aircraft should not climb and should not descend greater than 500 FPM. A failure to correctly follow preventative advisory vertical speed restrictions results in a corrective advisory.

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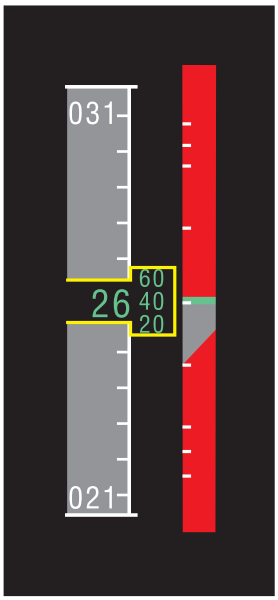
Preventative Advisory



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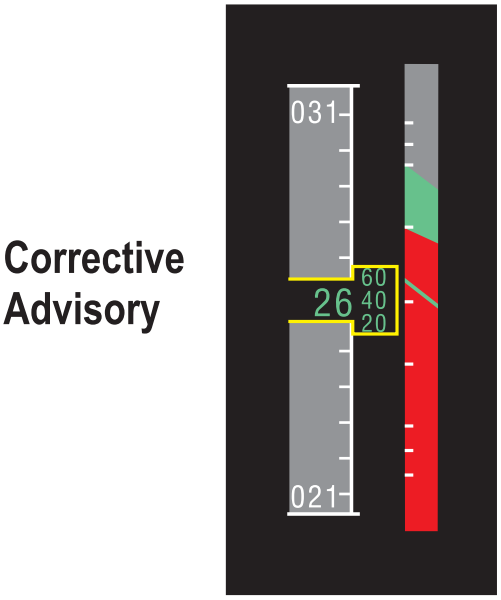
TCAS Advisories (continued)

Resolution Advisory (continued)

When a corrective advisory is displayed, the vertical speed should be changed into the green area, as indicated on the example PFD vertical speed indicator below.



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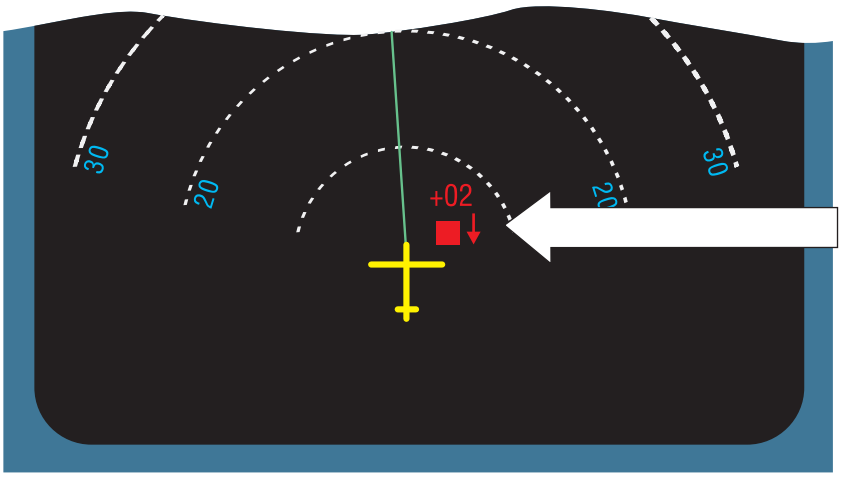
In addition to the vertical speed indications, aural commands correspond to the corrective advisory. The RA traffic is displayed on the ND as a solid red square.



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TCAS Advisories (continued)

Design Response to a RA

When an RA occurs, the TCAS assumes that the pilot will respond promptly and smoothly to the vertical command. The vertical speed should not be allowed into the red area. The flight control input required should be similar to that when responding to an ATC clearance to climb or descend immediately (0.25 G within 5 seconds).

Failure to respond promptly to an RA, or failure to maintain the commanded vertical speed, may result in a strengthened vertical command, or in an RA vertical command reversal. An RA reversal occurs when a climb command is changed to a descent command, or vice versa.

If the RA vertical command is strengthened, as indicated by an “INCREASE CLIMB” (or “INCREASE DESCENT”) aural warning, maneuvers should be initiated using an additional 0.25 G within 2.5 seconds.

If the RA vertical command is reversed, as indicated by a “CLIMB, CLIMB NOW!” (or “DESCEND, DESCEND NOW!”) command, maneuvers should be initiated using an incremental 0.5 G within 2.5 seconds.

Pilot response to an RA is not intended to be a precise maneuver. The G inputs and response time are provided to indicate the relative severity of the required pilot input. There is no requirement for the pilot to memorize these parameters.

Note: Maneuvers in response to an RA are discussed in detail in the FCTM.

Note: Due to the limited G authority of the autopilot, it cannot be used for the initial response to an RA. The pilot must manually fly the response to an RA.

If a climb RA occurs with the aircraft in the landing configuration, a go-around should be initiated in order to properly comply with the RA.

TCAS Advisories (continued)

Aural Annunciations

TCAS aural warnings are announced over the cockpit loudspeaker, and accompany the PFD and ND visual displays. The loudspeaker does not have to be selected on. The aural alerts are softened or strengthened depending on the urgency of the situation.

Traffic Advisory - The aural warning “TRAFFIC, TRAFFIC” is heard. This aural alert is inhibited at very low altitudes.

Resolution Advisory - When certain changes in vertical speed are unsafe, a “MONITOR VERTICAL SPEED” warning is heard. The present vertical speed is not within the RED prohibited area, and the pilot should keep the vertical speed out of the red prohibited area.

A “CLIMB, CLIMB, CLIMB” warning indicates that the rate of climb displayed on the vertical speed indicator should be promptly and smoothly established (1,500 FPM or greater).

A “DESCEND, DESCEND, DESCEND” warning indicates that the rate of descent displayed on the vertical speed indicator should be promptly and smoothly established (1,500 FPM or greater).

A “DESCEND, CROSSING, DESCEND” warning is the same as the “DESCEND” warning, and indicates that the aircraft altitude will cross the altitude of the intruder. A “CLIMB, CROSSING, CLIMB” warning indicates a similar crossing situation.

A “REDUCE DESCENT, REDUCE DESCENT” warning indicates that the pilot should smoothly reduce vertical speed to that shown on the PFD. A “REDUCE CLIMB, REDUCE CLIMB” warning indicates a similar situation.

Strengthened and Reversal RA Warnings - In rare circumstances, a TCAS RA is strengthened or reversed. This would occur when the intruder aircraft suddenly changes its current flight path. The pilot must respond immediately when the following aural warnings are heard:

An “INCREASE CLIMB” warning indicates that the pilot should promptly and smoothly increase the vertical speed to match the PFD vertical speed command. An “INCREASE DESCENT” warning indicates a similar situation.

A “CLIMB, CLIMB NOW!” warning indicates that the pilot should promptly and positively maneuver at an incremental 0.5G to establish a 1,500 FPM or greater climb, in accordance with the displayed vertical speed command. This aural warning follows a “DESCEND” command and is provided when circumstances require a reversal of vertical direction to ensure adequate vertical separation. A “DESCEND, DESCEND NOW!” warning indicates a similar vertical command reversal situation. The “NOW” aural command indicates a significantly increased collision potential and the pilot should immediately respond to the command.

Clear of Conflict - A “CLEAR OF CONFLICT” aural message is heard when a flight path conflict no longer exists. The pilot should promptly and smoothly return to the applicable clearance, unless directed otherwise by ATC.

Note: In the event the intruder track or altitude information is lost during an RA, the RA will terminate without a “CLEAR OF CONFLICT” aural message.

TCAS Advisories (continued)

ATC Clearance Deviation

The TCAS system uses the Mode S transponder to electronically coordinate resolution advisories and recommended vertical maneuvers. Therefore, RA vertical maneuvers should be followed exactly and maneuvers opposite to the RA are prohibited. The majority of RAs that require a flight path deviation are usually resolved with vertical movements of 300-500 feet. Careful attention should be paid to changes in RAs (i.e., when a RA downgrades from a corrective advisory to a preventative advisory) in order to minimize deviations from the ATC clearance.

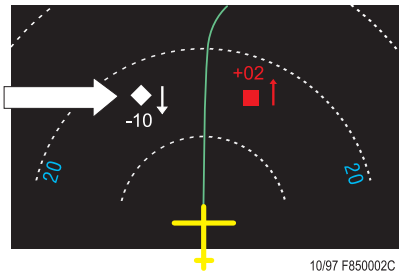
Crossing RA

The TCAS may command a vertical maneuver which results in the aircraft crossing through the altitude of the intruder. This is defined as a crossing RA, and occurs when one or both aircraft are climbing or descending at a significant rate. Separation is increased in this case by the crossing maneuver. The pilot can recognize a crossing RA by the aural warning “CLIMB, CROSSING, CLIMB” (or “DESCEND, CROSSING, DESCEND”). In any case, there is no requirement for the pilot to recognize a crossing RA, as separation is always maximized by following the RA vertical commands.

Proximate Traffic

Proximate traffic represents aircraft which currently do not pose a collision threat, but are within 6 NM and +/-1,200 feet vertically. When the TRAFFIC selector is in the AUTO position, Proximate traffic will only be displayed when a TA or RA intruder aircraft is also present. When the TRAFFIC selector in the ON position, Proximate traffic will be displayed with or without a TA or RA intruder being present.

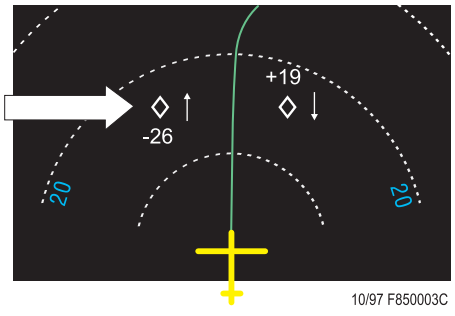
Proximate traffic is displayed as a solid white diamond on the ND.



Other Traffic

Other traffic represents aircraft which currently do not pose a collision threat, but are within 40 NM and +/- 2,700 feet vertically. When the TRAFFIC selector is in the AUTO position, Other traffic will only be displayed when a TA or RA intruder aircraft is also present. When the TRAFFIC selector in the ON position, Other traffic will be displayed with or without a TA or RA intruder being present.

Other traffic is displayed as a hollow white diamond.

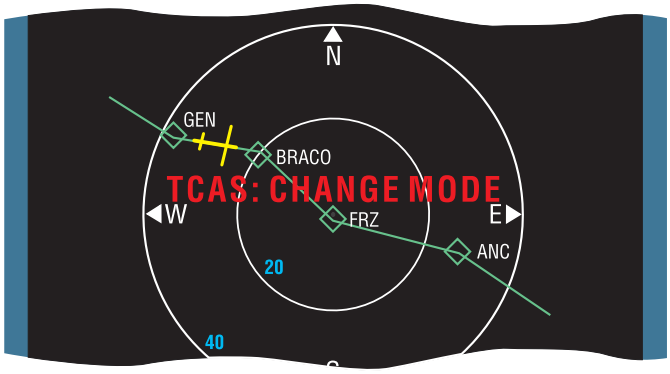


TCAS Advisories (continued)

Navigation Display

TCAS TA and RA information is displayed on the ND in all modes except PLAN.

If a TCAS TA or RA occurs when the EFIS ND mode is in PLAN, the ND message TCAS: CHANGE MODE appears requesting the pilot to select a different mode.



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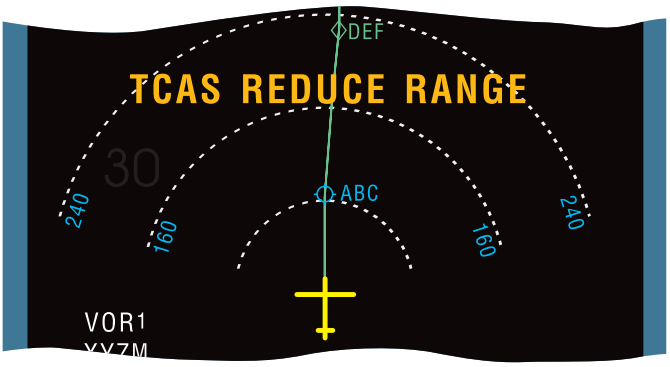
The ND range must be 40 nm or less for TCAS information to be displayed.

If the ND range is excessive and a TA or RA occurs, a TCAS: REDUCE RANGE message is displayed requesting the pilot to reduce the ND range.



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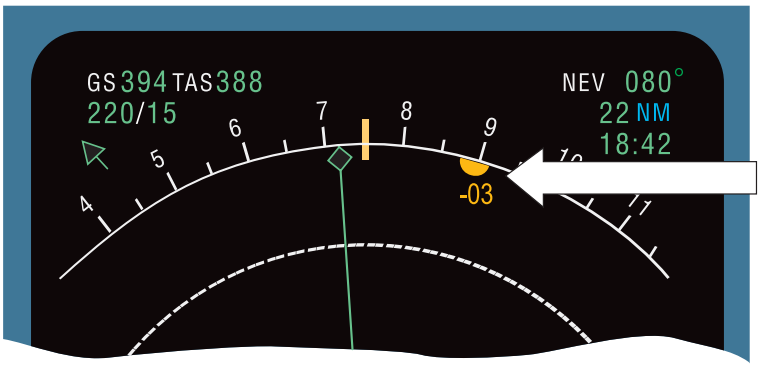
The messages appear in amber if a result of a TA, and in red if a result of an RA.

Off Scale Traffic Advisories

If the TCAS tracks an intruder that is outside the range of the display, but has entered the caution or warning areas, one half of the appropriate symbol is displayed at the edge of the display.



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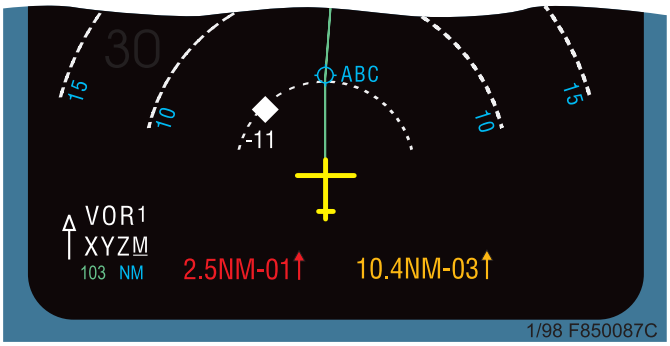
TCAS Advisories (continued)

No Bearing Advisories

If the TCAS is unable to track the bearing of an intruder, the traffic advisory appears at the bottom of the display, just below the own aircraft symbol. This phenomenon may be caused by a temporary condition (antenna shielding during turns, for example). The data block is displayed just below the aircraft symbol. The type of alert, distance to the intruder, and relative altitude information are displayed.

This example indicates two targets:

an RA at 2.5 NM range, 100 below and climbing, and a TA at 10.4 NM range, 300 feet below, and climbing.



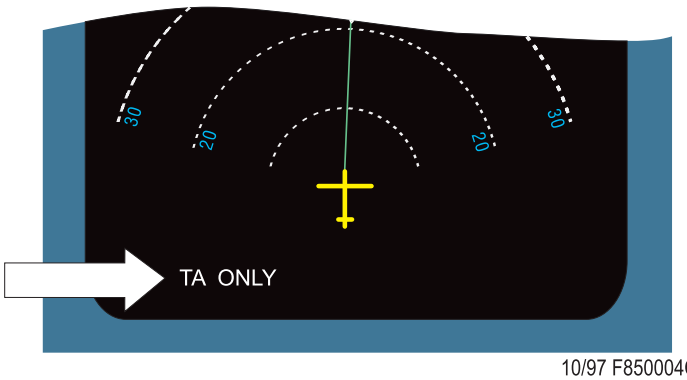
TCAS Inhibitions and Limitations

TCAS Altitude Inhibitions

TCAS operating characteristics are modified when operating at very low altitudes AGL. As the aircraft descends below approximately 1,700 feet AGL, the maximum rate of descent for descending RAs is progressively reduced. When below approximately 1,000 feet AGL, all RA warnings and all TA aural messages are inhibited. However, TA intruder aircraft are still displayed on the ND. Aircraft that are below approximately 400 feet AGL or less (ground traffic) are not displayed. These altitudes are approximate and will vary depending on system logic.

This message is displayed when the TCAS automatically inhibits RAs, or when the pilot has manually selected the “TA only” function.

This is a normal display at low altitudes with the RA/TA function selected.



The TCAS functions in the TA only mode if selected to TA or RA/TA on the ground. At low altitudes, it automatically operates in the TA only mode with the mode selector in both the TA and RA/TA positions. RA aircraft are displayed using TA symbology.

TCAS does not issue advisories when standard IFR separation exists at any altitude with both aircraft in level flight.

TCAS Inhibitions and Limitations (continued)

TCAS Design Limitations

The TCAS system does not consider aircraft performance when commanding climb rates during an RA. Consequently, TCAS may command a climb rate that may exceed the aircraft's capability. Conditions where this may occur are:

- significant bank angles,
- operation at high elevation runways,
- one engine inoperative,
- failure to select the go-around configuration and power with a climbing RA when configured for landing (this includes RA's with landing gear extended),
- speeds below normal operating speeds, and
- with a buffet margin less than 1.3 G (e.g., flight above the maximum altitude).

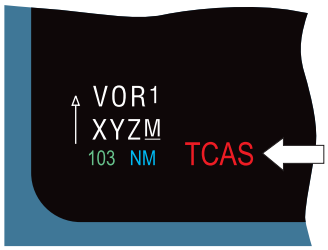
Selecting the mode selection switch to TA (only) eliminates RA vertical commands while still providing oral and visual TA warnings. This mode (TA only) signals other TCAS II equipped aircraft to make all RA vertical corrections.

TCAS Failure Indications

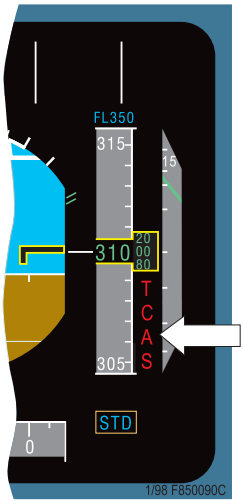
TCAS Failure Indications

A TCAS failure is indicated by:

a red TCAS flag on the ND and



a red TCAS flag adjacent to the PFD vertical speed indicator.

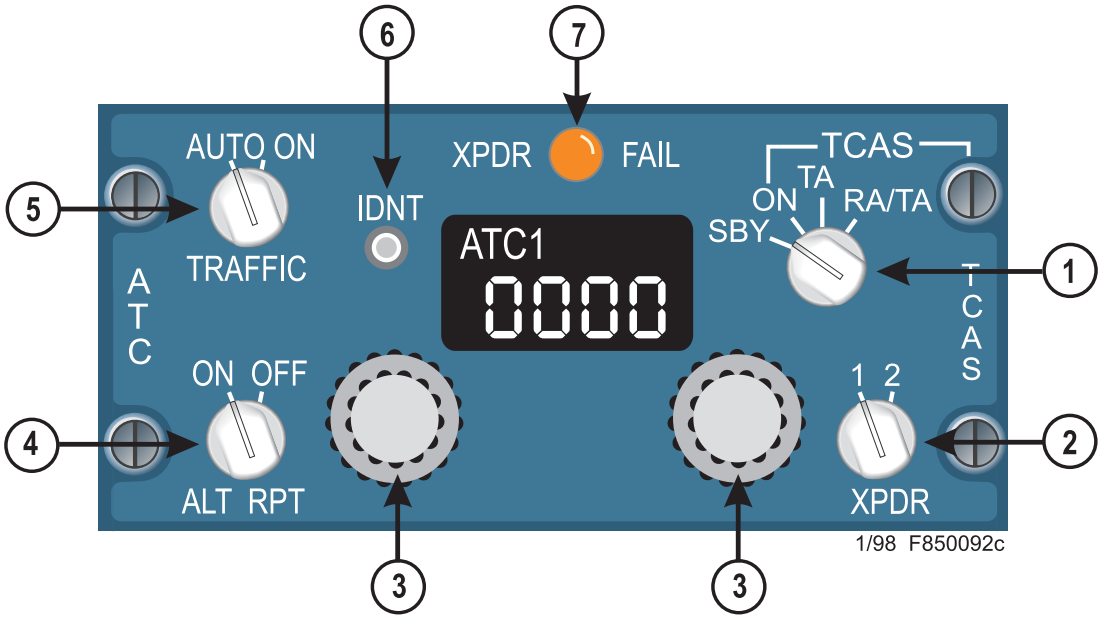


Note: The failure of the selected transponder also results in a TCAS failure.

TCAS/Transponder Control Panel

Function

TCAS and transponder modes are selected with the pedestal mounted TCAS/transponder control panel, as shown below.



1 Mode Selection Switch

The mode selection allows the transponder to operate in the following modes:

SBY The transponder is in standby and does not reply to interrogations. All TCAS functions are inhibited.

ON The transponder replies to ATC radar interrogations. All TCAS functions are inhibited.

TA The transponder functions as described in ON, and TCAS provides Traffic Alert (TA) displays, aural warnings, and proximate traffic. The message TA ONLY is displayed on the ND. RA traffic is displayed with TA symbology.

RA/TA The transponder functions as described in ON, and the TCAS displays TA aircraft, proximate traffic, and Resolution Advisory (RA) displays, aural warnings, and vertical commands on the PFD.

2 XPDR Selector Switch

The transponder (XPDR) selector switch allows the pilot to select either transponder 1 or 2. This switch also changes the ADR which provides the altitude signal for the altitude reporting. The selected transponder is displayed in the code display window.

3 Code Selection Knobs

The 4 code selection knobs are each used to select a digit of the transponder code.

TCAS/Transponder Control Panel (Continued)

4 **ALT RPT Switch**	The Altitude Reporting (ALT RPT) switch allows the pilot to select ALT RPT ON or OFF. When selected ON, an altitude signal is provided to ATC and other TCAS equipped aircraft.
5 **TRAFFIC Switch**	The traffic switch controls the ability to display Proximate and Other traffic. The transponder mode selection switch must be in TA or RA/TA for this switch to function. **AUTO -** Other and Proximate traffic are *only* displayed if a TA or RA intruder aircraft is present. **ON -** Other and Proximate traffic are displayed regardless of the presences of a TA or RA intruder aircraft.
6 **IDNT pb**	Depressing the IDNT pb provides ATC with an identification signal.
7 **XPDR FAIL Light**	The XPDR FAIL light illuminates whenever a failure of the selected transponder or its altitude source has been detected. This results in the loss of both the transponder and TCAS. For example, transponder 1 is selected, and transponder 1 or ADR 1 fails. This would result in the fail light illuminating until transponder 2 is selected.

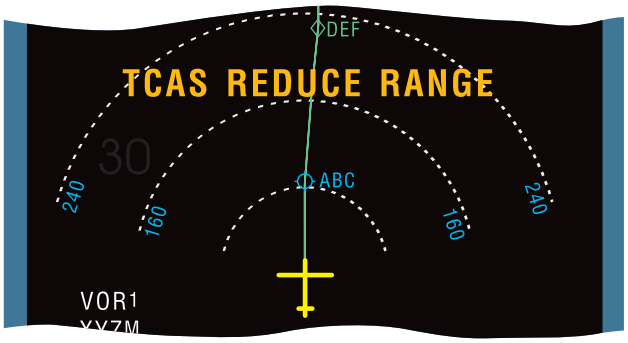
TCAS Display Symbology

Navigation Display

Range

The ND range must be 40 NM or less for TCAS information to be displayed.

If the ND range is excessive, and a TA or RA occurs, a REDUCE RANGE message is displayed requesting the pilot to reduce the ND range.



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Range Rings

Rings are provided on the ND display to assist in TCAS display interpretation.

In the example to the right, the first ring is at 2.5 NM, and the second ring is at 5 NM.

The TCAS range scale is displayed on the compass rose at the 7:30 position.

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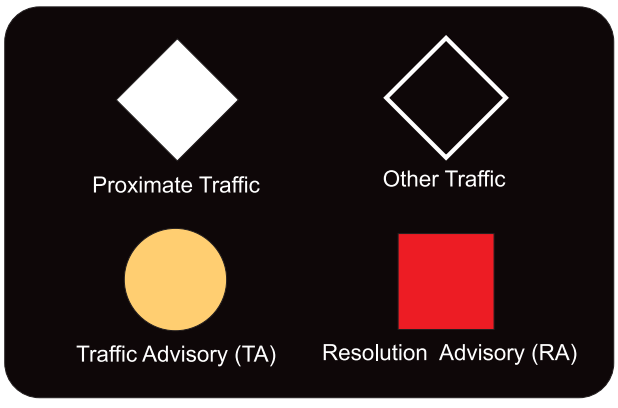
Aircraft Symbols

Aircraft symbols are shown below.



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TCAS Definitions

Definitions

Advisory

A message given to the pilot containing information relevant to collision avoidance.

Alert

Indication (either visual or audio) which provides information to the flight crew in a timely manner about an abnormal situation.

Caution Area

An area of airspace which begins 20-40 seconds from the time an intruder aircraft is predicted to enter the TCAS aircraft's collision area.

Collision Area

An area of three dimensional airspace, defined by TCAS, that varies in size contingent upon closure rate. This area surrounds a TCAS II equipped aircraft and is designed to prevent other aircraft from entering this area.

Intruder

An aircraft equipped with an operating Mode-A, Mode-C, or Mode-S transponder that has satisfied the TCAS II intruder detection logic and is predicted to enter the TCAS aircraft's collision area.

Mode-A

A type of transponder that provides a selected code reply (non-altitude) when interrogated. TCAS is unable to determine an RA from Mode-A replies. TCAS will provide TAs for Mode-A responding aircraft.

Mode-C

A type of transponder that provides an aircraft altitude reply in addition to the Mode-A information when interrogated.

Mode-S

A type of transponder which provides Mode-A and Mode-C replies to interrogations, as well as discrete Mode-S interrogations from the ground or air. Mode-S is the means through which one TCAS equipped aircraft “coordinates” avoidance strategies with another TCAS equipped aircraft.

Other Traffic

Any transponder equipped traffic within 40 nm and +/- 2,700 feet vertically. This traffic is not displayed when a TA or RA is present.

Proximate Traffic

Any transponder equipped aircraft within 6 NM and +/- 1,200 feet vertically of the TCAS aircraft. This traffic is displayed in conjunction with an TA or RA.

TCAS Definitions (continued)

Definitions (Continued)

Resolution Advisory

A Resolution Advisory (RA) is an aural message and a Primary Flight Display (PFD) vertical speed command which instruct the pilot on actions to be taken or avoided in order to maintain or increase vertical separation relative to an intruder aircraft. The advisories are designed to occur when an intruder's predicted flight path is within 20-25 seconds from entering the TCAS aircraft's collision area. Resolution Advisories fall into two general categories, corrective and preventative.

Corrective Advisory

An RA that instructs the pilot to deviate from current vertical rate.

Preventive Advisory

An RA that instructs the pilot to avoid certain deviations from current vertical rate.

TCAS Aircraft

An aircraft equipped with TCAS II.

TCAS II

TCAS is a system that utilizes interrogation of, and replies from, airborne transponders and provides TAs and RAs. The “II” designates a system which is capable of providing coordinated RAs in the vertical plane.

Traffic Advisory

A Traffic Advisory (TA) is issued when an intruder aircraft's predicted flight path is within 40-45 seconds from entering the TCAS aircraft's collision area. TAs are intended only for assistance in visually locating the traffic. These advisories lack the flight path trends necessary for evasive maneuvering.

Warning Area

An area of three dimensional airspace that begins within 20 seconds prior to the time the intruder is predicted to enter the TCAS aircraft's collision area.